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A VIEW OF THE PROGRESS OF DISCOVERY

IN NATURAL PHILOSOPHY, CHEMISTRY, MINERALOGY, GEOLOGY, BOTANY, ZOOLOGY, COMPARATIVE ANATOMY, PRACTICAL MECHANICS, GEOGRAPHY, NAVIGATION, STATISTICS, ANTIQUITIES, AND THE FINE AND USEFUL ARTS.

CONDUCTED BY

DAVID BREWSTER, LL.D.

F.R.S. LOND. SEC. R. S. EDIN. F.S.S.A.

HONORARY MEMBER OF THE ROYAL IRISH ACADEMY; MEMBER OF THE ROYAL SWEDISH ACADEMY OF SCIENCES; AND OF THE ROYAL SOCIETY OF SCIENCES OF DENMARK, &c. &c.

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ART. I.—*Observations on the Vision of Impressions on the Retina, in reference to certain supposed Discoveries respecting Vision announced by Mr. Charles Bell.* * By DAVID BREWSTER, LL.D. F.R.S. and Sec. R. S. Ed. &c.

THERE is no branch of physical science which has made less progress than that which relates to the optical functions of the eye. Although the phenomena of vision are constantly presented to our consideration, and although experiments without number, and speculations without end, have been accumulated, yet during the last century no prominent discovery has been made respecting the physiology of this most important organ.

It was, therefore, with no inconsiderable satisfaction, that I observed in the *Philosophical Transactions* for 1823, a paper by Mr. Charles Bell, containing an account of discoveries which promised to throw a new light not only upon the optical, but upon the metaphysical questions which have so long been agitated respecting vision. In studying that paper, however, these expectations have been disappointed. After a careful repetition of the experiments which it contains, and a minute investigation of the phenomena to which it relates, I have no hesitation in stating, that its facts and reasonings are to a great extent incorrect and inconclusive.

In submitting the results of this inquiry to the Royal Society, I trust it will not be supposed that I am engaging their attention to a subject of a controversial nature. I have no inclination to offer any criticisms, or make any comments upon those parts of Mr. Bell's paper, which are open to controversy. My only object is to establish certain scientific facts and laws of vision which have been misunderstood or perverted; and I shall but ill perform the task I have undertaken, if I leave the subject in any doubt, or fail to impress upon those who hear me, the same conviction of their certainty which I entertain myself.

---

* Read before the Royal Society of Edinburgh, December 6, 1824.

In order that the facts and doctrines maintained by Mr. Bell may not be misinterpreted, I shall state them in his own words.

> "When the eye is at rest, as in sleep, or even when the eyelids are shut, the sensation on the retina being then neglected, *the voluntary muscles resign their office, and the involuntary muscles draw the pupil under the upper eyelid.* This is the condition of the organ during perfect repose.
>
> On the other hand, there is an inseparable connexion between the exercise of the sense of vision, and the exercise of the voluntary muscles of the eye. When an object is seen we enjoy too senses; there is an impression upon the retina; but we receive also the idea of position or relation, which it is not the office of the retina to give. It is by *the consciousness of the degree of effort put upon the voluntary muscles that we know the relative position of an object to ourselves.* The relation existing between the office of the retina and of the voluntary muscles, may be illustrated in this manner.
>
> Let the eyes be fixed upon an illuminated object, until the retina be fatigued, and in some measure exhausted by the image, then closing the eyes the figure of the object will continue present to them: and it is quite clear that nothing can change the place of this impression on the retina. But notwithstanding that the impression on the retina cannot be changed, the idea thence arising may. For, by an exertion of the voluntary muscles of the eyeball the body seen will appear to change its place, and *it will, to our feeling, assume different positions according to the muscle which is exercised.* If we raise the pupil we shall see the body elevated, or if we depress the pupil, we shall see the body placed below us; and all this takes place while the eyelids are shut, and when no new impression is conveyed to the retina. The state of the retina is here associated with a consciousness of muscular exertion; and it shows that vision, in its extended sense, is a compound operation, the *idea of position of an object having relation to the activity of the muscles.* * * *
>
> *If we move the eye by the voluntary muscles, while this impression continues upon the retina, we shall have the notion of place and relation raised in the mind; but if the motion of the eyeball be produced* BY ANY OTHER

CAUSE, *by the involuntary muscles or by pressure from without*, we shall have no corresponding change of sensation.

If we make the impression on the retina in the manner described, and shut the eyes, *the image will not be elevated, although the pupils be actually raised*, as it is their condition to be when the eyes are shut, because there is here no sense of voluntary exertion. If we sit at some distance from a lamp, which has a cover of ground glass, and fix the eye on the centre of it, and then shut the eye and contemplate the phantom in the eye; and if, while the image continues to be present of a fine blue colour, *we press the eye aside with the finger, we shall not move that phantom or image*, although the circle of light produced by the pressure of the finger against the eyeball moves with the motion of the finger.

May not this be accounted for in this manner: The motion produced in the eyeball not being performed by the appropriate organs, the voluntary muscles, *it conveys no sensation of change* to the sensorium, and is not associated with the impression on the retina, so as to affect the idea excited in the mind? It is owing to the same cause, that, when looking on the lamp, by pressing one eye, we can make two images, and we can make the one move over the other. But if we have received the impression on the retina so as to leave the phantom visible when the eyelids are shut, *we cannot, by pressing one eye, produce any such effect. We cannot, by any degree of pressure, make that image appear to move;* but the instant that the eye moves by its voluntary muscles, the image changes its place; that is, we produce the two sensations necessary to raise this idea in the mind; we have the sensation on the retina combined with the consciousness or sensation of muscular activity."—*Phil. Trans.* 1823, p. 177—180.

The passage now quoted contains three important results:

1. That when an impression is made upon the retina by strong light, this impression, in the form of a coloured spectrum, remains absolutely fixed and immoveable, if the eyeball is moved by the pressure of the finger, or by any other external cause than that of the voluntary muscles of the eyeball.

2. That during sleep, or upon the closing of the eyelids, the voluntary muscles resign their office, and the involuntary muscles draw the pupil under the upper eyelid.

3. That during this involuntary motion or displacement of the globe of the eye, the spectral impression continues absolutely fixed and immoveable.

From these three results, Mr. Bell draws the highly important conclusion, that "it is by the consciousness of the degree of effort put upon the voluntary muscles, that we know the relative position of an object to ourselves," or that "the notion of place or relation is raised in the mind;" and hence he explains the old paradox of an inverted picture upon the retina producing the appearance of an erect object.

In estimating the value of this singular conclusion, we shall first admit its truth, as well as the correctness of the facts from which it is deduced, in order to form some notion of the consequences in which it will involve us.

Since the notion of place or relation depends solely on the consciousness of exerting the voluntary muscles of the eyeball, let the observer, with a spectral impression on his retina, close his eye, and turn round his head either in a vertical or a horizontal plane, *by the muscles of his neck alone*. It will now be found, that the spectrum follows the motion of the head; and hence we must conclude, that the notion of place or relation depends on the exercise of the muscles of the neck, as those of the eyeball have been entirely at rest.

But as there may exist some undiscovered sympathy between the muscles of the neck and those of the eyeball, let the observer, with his eyes closed be now placed upon a stool, to which an assistant communicates a rotatory motion through the intermedium of a leathern belt. In this case also, it will be found that the spectrum revolves with the stool in the same manner as if the eyeball had performed the same angular motion by the action of its voluntary muscles. Hence we must conclude, that the notion of place or relation depends on the muscles of the assistant's arm, conveyed by some sympathetic action to the observer's eye along the leathern belt; a result so inadmissible, that, to use the sentence which Mr. Bell directs against the illustrious Kepler, "The mind might as well follow the ray out of the eye, and like the spider, feel along the line."

In order to view this subject under another aspect, let us suppose that, by cutting the voluntary muscles, the eyeball is left to float in its socket; or, what is the same thing, that these muscles have lost their power of giving motion to the eyeball. In such a case, will the eye retain its notions of place or relation? or will it lose them entirely? It is quite clear that the impression of external objects on the retina will not be affected by this condition of the voluntary muscles; and therefore it follows, that if the notion of place is ost, the eye must either see the object erect as usual, or inverted, or in some intermediate position, or what is more probable, in all these positions at once. For if it has *a determinate position*, the eye will only have exchanged its notion of true position for a notion of false position, a result too absurd to be for a moment entertained. Fortunately for this argument, Mr. Bell has actually described a case under the care of Dr. Macmichael, which occurred after his paper was read. "In this case," says he, "which shows the consequences of the eye and eyelids being rendered immoveable, the surface of the eye is totally insensible, and the eye remains fixed and directed straight forward, *whilst the vision is entire*." If there ever was an *experimentum crucis*, which could settle at once a controverted question, we have one in the case now quoted. Dr. Macmichael's patient preserved his vision entire, when "the outward apparatus was without sensibility and motion," and when there was no consciousness of effort in the voluntary muscles to convey the notions of place and relation.

Although mathematicians have acknowledged the legitimacy of the *reductio ad absurdum*, which constitutes the principal feature of the preceding argument, yet we fear this will not be admitted in physical science, unless it is accompanied with an acknowledgment of our ignorance respecting the facts and principles which the paralogism involves. I shall therefore proceed to an examination of the facts themselves.

1. The leading fact which has misled Mr. Bell in this inquiry, is the alleged immobility of the spectral impression, when the eye is displaced by the pressure of the finger. This spectrum is by no means immoveable. It is quite true that it moves through a very small space; but this space, small as it is, is the precise quantity through which it ought to move according to the principles of optics; and the explanation of this fact leads us to investigate the difference between the vision of external objects, and that of impressions upon the retina.

In order to understand this difference, let A, Plate II. Fig. 1, be the eye of the observer, and O an external object, whose image at P is seen along the axis of vision POM. Let the eye be pushed upwards, suppose $\frac{1}{10}$th of an inch, into the position B, the external object O remaining fixed. The image of O upon the retina will now be raised from P to Q in the elevated eye at B. Hence the object O will now be seen in the direction QON, having descended, by the elevation of the eye, from M to N.

Let the eye be now brought back to its original position A, and let the object O be the lamp with ground glass used by Mr. Bell. The spectral impression will therefore be made upon the retina at P, and will remain on that spot till it is effaced. If the eye A is now raised to B, the impression will still be at P in the elevated eye, and it will be seen in the direction PR parallel to PM, having risen only $\frac{1}{10}$th of an inch, or the height through which the eye has been raised by pressure. This small space is not very visible to an ordinary observer, when his head is at liberty to move; but if the head is carefully fixed, the motion of the spectrum becomes quite apparent. Hence it is obvious that Mr. Bell has been first misled by not observing the motion of the spectrum, and secondly, by supposing that the vision of an impression followed the same law as the vision of an external object. The difference between these two cases of vision which Mr. Bell has overlooked, consists in this, that in *ordinary vision* the object forms a new image upon a new part of the retina, after the eye is pushed up; whereas in *spectral vision*, the original object has nothing to do after the eye is displaced, the spectrum itself which retains its place on the retina being now the only object of perception.

2. The *second* fact announced by Mr. Bell is, that during sleep, or upon the closing of the eyelids, the eyeball is involuntarily turned up beneath the upper eyelid, and so far even as to withdraw the pupil from the faint light which that eyelid transmits.

This singular result stands in direct contradiction to the opinion of Soemmering and other anatomists, who consider the eyeball as perfectly stationary when the eyelids are shut; but as Mr. Bell has deduced his opinion from direct experiment, it requires to be strictly examined. I have frequently and carefully repeated the experiment which he describes, and I find that no such motion of the eyeball takes place upon shutting the eyelids; but that, on the contrary, they remain perfectly stationary. I am informed also by

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of course we do not yet know what weight certain characters should have, when we attempt to separate the species into natural groups.

The characters, therefore, by which different authors have endeavoured to distinguish *Piper* from *Peperomia*, have been not only different, but it remains still uncertain whether the species that should be respectively arranged under these genera, according to such characters, would form two groups distinguished from each other by a remarkable difference in general appearance. It is also uncertain whether or not all the species of *Piper* can be reduced to the two genera, as distinguished by any characters yet proposed. For instance, Hedwig, (*Gen. Plant.* 22.) endeavours to distinguish the *Piper*, by its having no calyx, from the *Peperomia*, which has a calyx, consisting of one peltate scale; but the *P. nigrum* or *aromaticum*, the *P. betle*, and the *P. longum*, the oldest and best established species of *Piper*, have exactly this character, by which Hedwig endeavours to distinguish *Peperomia*.

The generic character given by Kunth to the *Peperomia*, (Spadix cylindricus floribus undique tectus. Flores hermaphroditi, *singulus* squama suffultus. Stamina duo. Antheræ uniloculares. Stigma indivisum. Bacca monosperma,) is very applicable to many species, and may distinguish them from the old established kinds of *Piper*, which, with several others that I have found in India, have a habit as well as a character (Spadix cylindricus undique tectus squamis unifloris. Flores dioeci. Masc. filamenta duo vel plura antheris bilocularibus. Fœm. germen unicum. Stigma sessile, profunde divisum,) very different from the *Peperomia rubella*, (*Hooker Exotic. Flora*, 58,) which nearly resembles a species from Nepal, which I gave to Sir E. J. Smith. But the *Peperomia incana*, (*Hooker*, 66,) and *Peperomia maculosa*, (*Hooker*, 92,) with the same character, have little or no resemblance either to the two species first mentioned, to the old established species of *Piper* with dioecious flowers, or even to each other. Until, therefore, the species of *Piper* have been more fully described, the subdivisions that have been made can only be considered as provisional, and merely as such I propose what follows.

On the hills near Goyalpara I found a shrub, which Linnæus would probably have called a *Piper*, but which differs a good deal both in general appearance and in the characters of its fructification, from any of the species yet mentioned. In the catalogue of dried specimens which I have given to the India House, this plant has been called CRYPHÆA ERECTA, on account of the sexual organs being concealed in a singular manner by the filament, which resembles a berry. I shall here give a description.

Frutices erecti. *Rami* oppositi, glabri, internodiis ad basin incrassatis compressis. *Folia* opposita, oblonga, ultra medium latiora, acuminata, mucronata, serrata, venosa, undulata, glabra. *Petiolus* brevissimus, annulo denticulato ramulum cingente amplexicaulis. *Stipulæ* alioquin nullæ.

Pedunculus communis terminalis, folio multo brevior, spicas gerens quatuor brachiatim oppositas, ultra spicas mucronatus. *Bracteæ* ad singulas spicas minutæ, ovatæ, persistentes, spicæ (vel si velis amenta vel spadices) erectæ, floribus oppositis quadrifariam imbricatis quadrisulcæ, glabræ, unciam longæ, mucronatæ. *Flores* albi, parvi, singuli denticulo spicæ insidentes.

Calyx squama minuta, acuta, denticulum spicæ bracteans. *Corolla* nulla. *Filamentum* unilaterale, ovatum, carnosum, extra convexum, intus sinu excavatum. *Antheræ* duæ uniloculares, marginibus filamenti infra apicem insertæ. *Germen* trigonum, filamentum inter et rachim intra filamenti sinum nidulans, denticulo spicæ insidens. *Stylus* brevis, crassus. *Stigma* acutum integrum.

Bacca ovata, carnosa, albida magnitudine pisi minoris, apice gerens. *Semen* unicum, globosum, læve, stipiti s. funiculo umbilicali e basi fructus prodeunti lignoso recto insidens. *Perispermum* magnitudine seminis album, durum. *Embryo* horizontalis, teres, rectus, indivisus, ab uno seminis latere ad centrum pertingens.

Plate II. Fig. 8, represents a flower cut vertically through the middle, and the nearest side removed. 1. Part of the Rachis communis. 2. Denticulus, on which the flower is placed. 3. Calyx. 4. Filament. 5. Anthera. 6. Pistillum.

Fig. 9. is a flower separated and viewed from the side next the rachis. 1, 1, 1, Filament. 2, 2, Antheræ. 3, Pistillum.

Fig. 10. is a vertical section of a berry. 1, 1, 1, Pulp. 2. Seed with embryo. 3. Stipes supporting the seed.

The figures are a little magnified.

Art. III.—*On the Theory of the Existence of a Sixth Sense in Fishes; supposed to reside in certain peculiar Tubular Organs, found immediately under the Integuments of the Head in Sharks and Rays.* By Robert Knox, M. D. F.R.S.E. &c. Communicated by the Author.

In dissecting the shark, tope fish or skate, none, I think, not even the most careless observer, could have missed noticing certain groups of very singular organs, which seem as it were peculiar to these families of animals. They were long confounded in anatomical descriptions with the lacunar or mucous system, which I believe to be common to all, or at least to most fishes, until clearly shown by Mr. Jacobson of Berlin, to be perfectly distinct from the latter, and differing probably as much in function as in structure. Mr. Jacobson concluded from his dissections, that they were organs of touch; and however improbable this opinion may at first sight appear, it seems not unlikely that it will ultimately be very generally adopted.

The organs I allude to have been long known to comparative anatomists, nor indeed is it possible to examine even with ordinary attention the head of the shark, without perceiving very readily their general structure:—A vast assemblage of parallel transparent tubes, filled with a gelatinous fluid, and supplied with large branches of nerves, communicating with a flat surface, and as it were perforating the integuments. Such are the organs I now speak of, and which, in whatever way they are viewed, merit the highest attention on the part of the comparative physiologist.

To form a sufficiently accurate idea of these organs, the reader has only to imagine a congeries of comparatively small tubes, springing from a common stalk like grapes from a vine branch; of a cylindrical form, and greatly resembling in shape a champagne glass; each of these is supplied with a nerve, forming as it were the stalk of the glass or tube: this is filled with a gelatinous body, strongly resembling the vitreous humour of the eye.

It has been said by a distinguished anatomist,* "that the interior of these vesicles or tubes is divided into compartments by longitudinal septa or divisions;" but this is an error which does not require any refutation. The contained gelatinous matter is perfectly cylindrical, and the tubes, though they appeared to me homogeneous in texture, were found to be composed of fibres perpendicular to the axis of the tube. I am indebted for this fact to Dr. Brewster, who at my request examined several of the tubes under a microscope of high powers. Dr. Brewster, at the same time, mentioned to me his suspicion that the fibres, of which the tubes were very evidently composed, were not circular, but spiral, and that the whole tube might thus be composed of a single fibre.

---

* Treviranus.

The tubular organs undergo various modifications, according to the tissue in which they are placed, and according to the nature of the parts they have to pass through on their way to the surface; on the snout, they do not appear to reach the skin entirely, at least every where, as there is interposed a thick cartilaginous lamina into which they scarcely penetrate; and accordingly, though most abundant on the upper and lower surfaces of the snout in the *tope*, by no artificial pressure can the gelatinous or vitreous contained matter be forced through the pores of the skin, which nevertheless are here very abundant. On the other hand, around the mouth, and even the orbits, the gelatinous matter can be forced through the pores of the skin by very gentle pressure. In some parts of the snout, the tubular organs approach quite close to the integuments; they become much firmer, and of a transparent horny texture; when cut through, a mass of them greatly resembles a honey comb. Over the orbits they run in long tubes, having parietes of a dense white fibrous structure, but are still evidently the same organs, and perhaps having their roots in the one or other of the two great gelatinous masses placed on either side the snout, forming the great bases of the tubular organs. The latter are, however, rather imbedded in the large gelatinous mass, and do not absolutely seem to grow from it; that is, the large branches of the fifth pair of nerves penetrate into these masses, and dividing into extremely numerous and detached branches send one to each of the tubes. The tubes are entirely shut at the extremity next the nerve. I did not observe any thing peculiar in their peripheral extremities. When we remove one of the tubes and place it under a microscope of small powers, we perceive that the nerve is distributed to the short extremity of the tube by fibrils. Let *a*, Plate II. Fig. 18, represent the tube filled with the gelatinous matter; *b* the nerve, dividing into several small branches, which creep up to a short distance perpendicularly on the sides of the tube. But if the extremity of the tube be examined after cutting the nerve across, then the distribution of the nerve may be well enough understood by inspecting Fig. 19, in which the nerves seem to proceed from the centre to the circumference like the spokes of a wheel.

When strong pressure is applied, the gelatinous fluid filling the tubes passes by narrow apertures into the canals of the lacunar system; but I consider this as by no means proving a direct communication, for we never perceive any of the gelatinous fluid naturally in these canals, nor scarcely any thing else, as M. de Blainville very well remarks in his account of these organs.

In the thorn-back, the arrangement of the tubular organs in the snout is precisely as in the tope or shark; but the tubes of the lacunar system are much more developed and distinct. In the specimen I last examined these tubes contained only a few globules of air, and a small quantity of a mucous fluid.

What are the functions of the tubular organs? And for what purpose have nerves been distributed to them in such abundance? Mr. Jacobson (a distinguished German anatomist) has replied to this question; *he considers them to be organs of touch, almost active.*

If I mistake not Mr. Jacobson's opinions, (which have been given to the public only through the medium of Dr. De Blainville,) that gentleman views the tubular organs, though terminating on extended smooth and flat surfaces, as organs of touch; against which opinion it might be argued, that the peripheral terminations of these organs are but ill adapted to exercise the sense of touch, which we find in almost all animals to be more or less connected with a prehensile and muscular tissue, calculated to be extended and applied in some way or other to the surfaces of bodies; 2*d*, That in many fishes there are organs of touch of an entirely different form, relative to whose functions no doubt can be entertained; *lastly*, That these peculiar tubular organs exist in certain fishes, inhabiting chiefly the great seas; and it is difficult to imagine on what occasions these organs could be so exercised so as to ascertain the presence of other bodies by touch.

G. R. Treviranus, to whom the minute anatomy of insects owes so much, has advanced the opinion, that the tubular organs of sharks and rays exercise a sense perfectly peculiar and distinct from those which man and other animals possess; that the number of the senses which may exist in animals ought not to be limited to five (the number usually assigned to man); but he at the same time admits, that the precise nature of the functions exercised by these organs remains still a profound mystery.

We need not here stop to discuss these hypotheses, which are really without any foundation; they may be classed with the sixth sense invented by Buffon, with the theories of Spallanzani relative to the accurate flight of bats through darkened chambers, after he had destroyed the organs of sight and hearing, leaving to them that organ of sense, by which the flight was really directed; or with the *sense of resistance*, which a skilful metaphysical writer invented and defended so plausibly.

We cannot, I imagine, greatly err in considering these organs as organs of touch, so modified, however, as to hold an intermediate place between the sensations of touch and hearing. They may perceive the undulations of the waters, and seem admirably adapted for this purpose by the quantity of nerves distributed to them; by the interposition of a tremulous gelatinous body interposed between the sentient extremities of these nerves and the impressing medium, and by the intimate connection of the sixth and auditory pairs of nerves of fishes.*

The boldness and rapacity of the shark, and perhaps also of the ray, imply the presence of active organs of sense. The eye-ball is large, and the sight apparently tolerably good, but quite inadequate to explain the facility with which the shark discovers and follows a vessel through the trackless ocean; it is not improbable, therefore, that he owes this faculty to the organs we have just endeavoured to describe. The undulation of the water caused by a tolerably large vessel must be sufficiently strong to impress a sensation on organs so exceedingly delicate, and to advertise their possessor of the presence of a living or at least a moving body.

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* The similarity of the peripheral terminations of these nerves with the auditory in most animals is forcible and very striking.

There is still another reason for supposing these organs to exercise, though in a peculiar way, the sense of touch. It is this: Linné notices several sharks as possessing a sort of cirri around the mouth, and particularly under the throat and lower jaw; and the same appearances have been remarked by a late observer as occurring in the enormous ray frequenting the seas of the West Indian Islands; now, these cirri may, perhaps, be mere prolongations of the tubular organs, or a substitute for them.

Thus it would seem that the nerves of the fifth pair undergo considerable modifications in different animals, according to the nature of their peripheral terminations. When expanded in the papillae of the tongue, certain branches of this nerve in most of the mammalia become gustatory; in the proboscis of the elephant, of the tapir, and in the prolonged snout of the pig, mole, ornithorynchus, and duck, they are true organs of touch, less perfect than the human hand only by reason of the form of the organ on which the nerves terminate. In certain fishes possessing labial cirri, they very evidently exercise the same sensation, viz. that of touch: *lastly*, in sharks and rays they are distributed to a new organ, holding as it were an intermediate place between touch and hearing, but approaching nearest to the latter. If we view these nerves in fishes anatomically, and compare them with the true auditory, it is evident that a close analogy must subsist between their respective functions; for in most fishes they are so intimately united at their point of communication with the brain, that most comparative anatomists have viewed the auditory as a branch of the fifth, (which, however, is not strictly true;) whilst peripherally they each terminate in, or are expanded on a substance exceedingly well adapted to perceive the undulatory vibrations of the medium in which they live. It is reasonable to think, that organs whose functions are such as we have supposed these to be, would necessarily be found chiefly in those animals whose habits of life most required their presence; and it would seem that in the shark they are most extensively developed, and, at the same time, most actively employed.

ART. IV.—*On the Natural History and Physical Geography of the Districts of the Himalayah Mountains between the River-Beds of the Jumna and Sutluj.* By GEORGE GOVAN, M. D.* Communicated by the Author.

THE districts in the Himalayah to which the following observations apply, are situated chiefly between the river-beds of the Jumna and Sutluj, which form their boundary; the former on the south-east, the latter on the north-west and partly on the north; the plains of Hindostan forming the south-west frontier.

The whole tract is included nearly between the parallels of north latitude 30° 25′ and 31° 50′, which is probably about the farthest point to the northward which the bed of the river Sutluj reaches.

Its greatest breadth is from longitude 76° 30′ to 78° 40′, from the junction of the river Lee, or Speetee, with the Sutluj to the farthest point west which that river reaches before emerging from the lower hills near Roopoor.

Viewed from the plains of the upper provinces, this belt of mountain district presents the appearance of parallel ranges in different numbers at different places, gradually towering above one another from the low ranges in the immediate vicinity of the plains; some of which are really nearly parallel to each other, until the view is terminated by the summits of the snowy ridges, shooting up in the back ground, arranged in a direction nearly north-west and south-east; parallel to these, the whole of the ranges in front have the appearance of being disposed, but on examining the grand lines of high level, as indicated by the sources and course of the diverging rivers, it will be seen that this appearance is a deception, some of the principal mountain-ridges, as well as the largest rivers intersecting the country in lines, more nearly at right angles to the direction of the snowy ridge; these, however, being viewed from the plains in the line of their direction, the subordinate lateral ridges which they, in their turn, send out at different angles, give an appearance of parallelism to the whole.

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* This interesting paper was read before the Royal Society of Edinburgh on the 6th of June, 1824.

The plains of Hindostan, at their northern extremity, where they adjoin this part of the hilly tract, have an elevation, probably of from about 800 to 1000 feet above the level of the sea. Saharanpore is stated as 1013 feet, by Captain Herbert, from an observation of the mean elevation of the barometer during August, compared with the mean of the same month in Calcutta.

The data upon which the elevations of different points in the Himalayah have been calculated, both barometrically and trigonometrically, are now before the public. From 15,000 to 16,000 feet above the level of the sea have been assigned to the crests of the passes in the branch of the chain to the southward of the Sutluj bed, (that which I have chiefly visited,) and which have been crossed by several different observers. From 3000 to 4000 feet more to the inaccessible summits on either side. Upwards of 25,749 feet has been stated by two eminent mathematicians, Captains Hodgson and Herbert, as the elevation, trigonometrically ascertained, of one of the Jowahir peaks.

Lastly, two observers (Messrs. Gerards) of unquestioned zeal, industry, and intelligence, in that part of the chain to the northward of the Sutluj, have actually reached, with barometers in an efficient state, an elevation where the mercury sunk to 15° 180, 15° 220 at mid-day, and 14° 675. T. 21°. Thermometer standing at 23° and 24°. If the Sutluj bed, not far from its reputed source in the lake Rāwun Rhudd, is nearly 15,000 feet, for which we have Captain Webbe's calculation, the high level connecting this part of the Himalayah with the plains of Tartary, and separating the waters of the Indus, the Ganges, the Sutluj, and the Burumpooter, situated on such a base, may yet lead to loftier summits in the interior.

Perhaps it is yet necessary that some plan should be suggested by which all the accuracy of which they are susceptible may be given to barometrical approximations under such circumstances.

Calculations have usually been founded either upon comparison with the medium height of the barometer in Calcutta, or at the level of the sea (perhaps 1200 miles off) during the month in which the observation on the mountain was made.

Even where cotemporaneous observations are obtained, have we ascertained that the alterations of atmospherical pressure in any accessible part of the Himalayah and Calcutta, are cotemporaneous?

During the cold weather months in India, when the atmosphere all over the country is in a state of comparative tranquillity, and the barometer is said hardly to vary above $\frac{1}{10}$th of an inch at Calcutta, and that only at the usual diurnal periods of variation, perhaps a calculation respecting the elevation of any point in the northern part of the plain, or any accessible point in the mountain belt, without any cotemporaneous observation, would give a more correct approximation than at another time of the year with one.

Unfortunately, the greater elevations are inaccessible at this time of the year, which, otherwise, might perhaps be considered as the best for obtaining correct results.

It were vain to attempt describing the enthusiasm and delight experienced by the admirers of nature on first entering these districts with the invading army in the end of 1814.

Inhabitants of the north, long exiled from the place of their birth, and contending with the fiery atmosphere of the tropical regions, can alone conceive the pleasure which many derived from the approach to a northern climate, and the gradual appearance of the features of a northern landscape, which the pines, more than any other vegetable, contributed to give to the wooded heights, while the streams were more animated and cheerful, from their clearness, rapidity, and pebbled beds, so different from the sluggish and muddy waters of the plains, their unvaried surface and monotonous productions.

To the more philosophical admirers of nature, the prospect of an ascent from the alluvial depositions going on under the eye in the river bed of the Ganges, through an unexplored country, to the primeval summits, forming the southern crest of the high table-land of Tartary, through all the gradations between a tropical and a polar flora, promised objects of still higher interest.

The snow-clad mountain barrier, long seen and admired from the plains of Hindostan, at distances even of 150 miles, skirting the whole of the north-east frontier for 500 or 600 miles, of which the sublime and imposing aspect had consecrated it among the Hindoos as a favourite residence of their gods, is now accessible at many different points; and a long, laborious, and patient investigation, requiring time and the union of numbers, will be requisite, before the various objects interesting to science which it contains can be properly investigated, or the amount which it is capable of furnishing, to increase our knowledge of geology, mineralogy, botany, and meteorology, completely ascertained. The assistance, also, and suggestions, of the learned in Europe, must be highly necessary to those who, in a climate unfavourable to the European constitution, and secluded both from the means of information furnished by society and books, are, with no trifling personal exertion, directing their inquiries to these subjects.

Those whose taste leads them more directly to the practical application of all acquired knowledge, to improvement in the moral and physical condition of the human race, its noblest purpose, will here find ample fields for their benevolent exertions and enlightened suggestions, in the low and debased condition of the human inhabitants, in many parts of this interesting region, over whose destinies the British government has been called to preside. Divided among themselves, and the rule over the numerous smaller states having long been a constant object of contention among the larger; or, at a later period, over-run by the Ghoorkali power, and many of them treated with a barbarity proportioned to the gallantry with which they resisted its aggression, under the government of warlike chiefs, whose principal object, during their short rule, was the realizing to the utmost all the revenue which the severest measures could exact, little opportunity of improvement has been afforded them.

In many parts of the country may be seen ruined villages, buildings, and temples, as well as numerous artificial flats for cultivation, now unoccupied, works both of much time, labour and expense, evidencing some former period of prosperity, population, and leisure, such as no longer exists.

Wars and misgovernment, attended by famine and pestilence, are the causes usually assigned for this by the people themselves. During even the common occurrence of a scanty crop, the difficulty with which the petty states in the interior could supply themselves from more fertile countries was very great; the bulky commodities which they had to give in exchange having to be transported by themselves, from the want of roads and beasts of burden, and across the territories of neighbouring chiefs, subjected to innumerable and arbitrary exactions in their transit. So that any temporary pressure of the population against the available supply of food, has here been invariably productive of crime and misery, unexampled in many other parts of the globe, equally or more sterile in respect of resources, but better regulated and more elevated in the scale of moral and intellectual existence. It may be sufficient only to mention the facts which have obtruded themselves upon the observations of all British officers employed in these districts, without dwelling upon them, that bloodshed seems to have been a common occurrence in private quarrel between members of the different states; as also the sale of females among each other, and the exposure of children, particularly the females, not as practised among Rajpoots in different parts of India from family pride, lest, not finding suitable matches, they might degrade themselves by intermarrying with inferiors, but chiefly from the mothers being unable to spare time from their other duties to rear infants, likely ultimately only to add to a population increased already beyond its steadily available means of subsistence. Hence also polyandry, common almost throughout the country, particularly the interior and poorer parts of it, which must not only be considered as an evidence of some great derangement in the constitution of society, but can hardly be supposed to have any other than a most injurious effect upon the moral character of the people.

It has been doubted what became of the superfluous females in countries similar to these districts, and Thibet, where polyandry prevails. The practice of exposing or destroying, particularly the female children, and the marts established in the vicinity, in former days, (when such traffic was permitted,) for the sale of slaves, form probably sufficient answers to this question.

From many of the causes to which these evils owed their origin the country is now happily freed. Conquered by the British from its Goorkali invaders, in a contest which could not with honour be avoided, it has been restored to its former chiefs. Property has been secured, nor will the former temporary expedients of a petty and short-sighted authority, in collecting the revenues, which are obviously injurious to the future prosperity of a state, be permitted under their presiding eye. That eye, however, cannot safely be withdrawn. It seems very doubtful whether, during the exile into which many of the restored feudal chiefs were driven by the Goorkali, and in the state of indigence and dependence to which they and their families were reduced, that liberality and those high qualities by which arbitrary power is rendered tolerable or even useful to a community in certain states of society, have been much cultivated in their characters. The very security, too, of the restored chiefs, under the British government, deprives the subjects, in some degree, of one of the most powerful means they formerly possessed of insuring a mild and paternal exercise of the feudal authority.

An attempt on the part of any of the paramount authorities to levy a larger sum for the protection afforded to a smaller state, than the protected found it for their interest to pay, was resented by a defection, not easily prevented in a country possessed of such strong natural defences to the banner of a rival state. The subjects of a petty chief found shelter and protection, under similar circumstances, in the territory of a neighbour more able or more willing to be generous and conciliating in his dealings with those under his protection.

The power of emigration still remains as a remedy, but in no part of the world is this willingly exercised. And here it is still less readily resorted to, from the bad effects of the climate, either of the plains or of the lower hills, upon the constitutions of the inhabitants of the more elevated regions; the more durable and expensive structure of the houses, renders them valuable property, and less willingly abandoned by their possessors, than the almost moveable huts of the plains of Hindostan, formed of mud, straw, and bamboos, even if we allow nothing for that attachment which, even among the mountaineers of these degraded regions, subsists for the imposing scenes which have associated themselves with their earliest impressions.

While the attention of a liberal and enlightened government is directed to the removal of the obstacles to prosperity and happiness, which in these states have hitherto existed, it will remain for those occupied in scientific pursuits, after acquiring accurate information respecting the natural productions and resources of the country—its varied climate, soil, agriculture, and capacities, to suggest whatsoever may appear to them likely to promote internal improvement, among people so situated, as indicated by the practices of more enlightened states, inhabiting a country similar in physical circumstances;—to make known to them many of their own vegetable productions, applicable to use in medicine, and in the arts with which they themselves may be yet unacquainted;—and to effect an exchange of vegetable productions, mutually beneficial to both, between them and this country, which I am persuaded will be ultimately done, as several successful experiments have already been made.

The evidence given, by the presence of allied genera and species in our districts of the Himalayah, that we may ultimately be able also to raise those which, in other parts of the world, are usually found associated with them, and which may contribute in the most essential manner to the internal improvement of the country, is one of the most important subjects to which the attention of a naturalist in the Himalayah can be directed.

In this comparatively small section of a country possessing such extent of mountain surface, it is evident, that to acquire a correct notion of its geological structure, a long, patient, and laborious examination would be necessary, into the extent, elevation, superposition, and internal characters, evidencing identity in the rocky masses, of which it is composed in approaching the snowy ranges, and the ridges proceeding from them at many places, and by different routes.

In a country where the climate, the soil, and its productions, as well as the aspect or physiognomy of its different belts of elevation, are constantly varying as we ascend; where our progress is marked by the successive appearance of plants, often the inhabitants of latitudes widely distant from each other; where we gradually get habituated to form a tolerable rude estimate of our elevation, by the associated genera we observe in their natural situations around us, it is obvious that the field for botanical research must be equally extensive. In these districts are found many species belonging to those genera of plants, with which in Europe we are familiar, approaching in some cases so near to the European species, as only to be discriminated from them by the practised botanist. Many fine species of our most noble fruit and forest trees, flowering shrubs, plants used in medicine and in the arts, and many congeners at least, if not the individual species, which form the chief vegetable riches of other regions where they flourish, here likewise make their appearance.

The laws observed in their geographical distribution, their natural associations, the peculiarities of soil, climate, and elevation, which seem best suited to give to each its highest development and most perfect form—the interesting analogies which press themselves upon our observation between the European, the American, and Asiatic alpine countries in their botanical geography, all form so many interesting objects of attention, that we turn with regret to the necessary labour of specific discrimination, here rendered particularly an ungrateful task, from the want of Herbaria, and works of reference.

In the short account which I am at present able to give, of a few of the most striking facts pervading so interesting a field for observation, will only be traced the outline of a plan which I had laid down for myself, to which time, and more favourable circumstances only could have enabled me to do any justice; as during the two or three journeys which the liberality of government enabled me to make through the Himalayah, I was labouring under irregular attacks of intermittent, which, at last, necessitated my undertaking a voyage to the *Cape of Good Hope.* This place the vessel, from stress of weather, being unable to make, I returned to this country, leaving many of my materials in India. I am anxious, during my residence in Britain, to add as much as possible to the accuracy of my mineralogical knowledge, and to derive, from my intercourse with the members of a society, to communicate with whom I consider so high a privilege, as many suggestions as possible, for the direction of my future inquiries, in case I may ever again return to the districts in question; the period of my first acquaintance with which will ever form a marked era in my life, from the interest then excited in scenes so imposing and remarkable.

Before proceeding to detail a few of the phenomena which present themselves on entering the hilly tract at the foot of the Himalayah, it may be proper to premise a few topographical remarks on the country forming the northern extremity of the plains of Upper Hindostan, between the river beds of the Sutluj and Jumna. These leave the hills at a distance from each other of about eighty British miles, the latter a clear stream in a broad comparatively shallow bed, filled with rolled stones, rapid at its first exit, particularly during the rains, but soon showing, by its division into different channels and windings, the flatness of the level at which it has arrived. The extensive Sal forest and grass jungle, composed of gigantic species of saccharum, (among which elephants might remain concealed, during the rainy months) to be found at this place and its vicinity, made Padshahmuhul a favourite spot, to which the Delhi emperors were wont to resort, in order to enjoy the diversion of hunting. When the smaller streams are dried up by the heats of April and May, it abounds with wild elephants, tigers, leopards, and the hog and spotted deer. Its closeness from surrounding heights, however, and the unhealthy vapours and heavy night dews which fall during the rainy months, make it a most unhealthy residence at that time, when it is only visited by the woodcutters, preparers of actechu, or by travellers, who pass through without remaining a night if possible.

The remains of a royal palace are still to be seen here, upon which the jungle has encroached on all sides, so that tigers have been roused within a few yards of its mouldering walls. There, in the days of Bernier's visit to Delhi, whose descriptions it is so interesting to contrast with the present state of that capital, the splendid courts of the Mogul Emperors encamped around their prince.

In no situation do the reflections of the eastern poet upon the instability of human greatness impress themselves more strongly on the imagination.

Spiders have woven their webs
In the halls of the Cæsars.
The owl stands sentinel
Upon the watch-towers of Afrasiab.

A tradition prevails among the people that many of the ladies of the court became affected with the goitre from residing here, a malady sufficiently common in different parts of the Himalayah, but which I have not often seen here, although sallow unhealthy complexions and enlarged spleen, the usual sequelæ of intermittents, are common enough.

A great contrast exists between the districts of the Dooab, of the Jumna, and Ganges, where they adjoin to the hilly belt, and those farther to the south-west, lying towards the river district of the Indus.

The Saharunpoor district, in the upper part of the Dooab, (country between two rivers,) was reckoned one of the most fertile and productive belonging to the Mogul empire. The depth of rich soil,—the proximity of the water to the surface,—the numerous streams by which it is intersected from the hills, perhaps the effects resulting from the striking of the prevailing westerly or south-west winds upon the line of the hills, all conspire to give it its peculiar characters, as well as the extent of *Kadir* lands, or lands flooded during the rains, almost all the rivers having an extent proportioned to their size of this *Kadir* land in their vicinity, and a high bank, marking the extent of their annual inundations, often at a very great distance from the diminished stream of the cold and dry seasons.

Vast extents of lofty grass jungle, abounding in wild animals, often occupy these occasionally flooded tracts.

The nights in the Kadir land are often excessively cold to the feelings, and a much heavier dew is deposited than in the higher lands. The endemic disease of the country is bilious remittent, terminating in obstinate ague, if not fatal at first. The countries on the right bank of the Jumna, on the contrary, and proceeding towards the Indus, seem more favourable to animal and less so to luxuriant vegetable life.

Water is found at great depths; from 50 it is said to 250 feet, or even 300, I have heard, and is often brackish. Most of the streams only flow during the rains, and are frequently lost in the sands.

An inundation of drifted sand in some places is apt to cover any tract left for a time uncultivated, and the immense quantities of saline matter contained in most of the wells, appear like hoar frost upon the grounds where irrigation has been going on.

Proceeding farther to the S. W. we have the *Skekowat* country, and the sandy desart of *Bicanere*, crossed by the Cabul embassy, generally almost a flat, with the exception of a few low rocky hills, the Indus being said to leave its last hilly boundaries of rock salt at Kalabaug.

The salt lake of Samhur is also a feature in the topography of the country, which is twenty miles in length and one mile and a half in breadth ; the evaporation of this, by the heats of summer, leaves a solid mass of salt a tolerably pure muriate of soda ; the immense quantities broken up and carried away being annually supplied by fresh depositions, after the rains of the following year.

Farther to the south we have the maritime district of Cutch, in which is that tract of country called the Runn, a dead flat, hardly elevated above the level of the sea, said to have a square surface of nearly 8000 miles, resembling an arm of the sea, from which the water had seceded, covered with saline incrustations and marine exuviæ frequently, of which during earthquakes a great portion has been occasionally covered with water, as was said to have occurred in 1819.

The low elevation of this whole tract of country above the level of the sea, (the few observations I have of the barometer, though I do not consider them as perfectly satisfactory, at Rewarrie, giving its height at from 800 to 900 feet,) its deep alluvial soil, its generally sandy and saline character, would give considerable interest to any attempts that might be made to ascertain the strata of which it is composed, particularly the nature of the organic remains contained in the strata of white friable limestone used for building, and said to be found in many parts of the sandy desart.

That the sea here extended considerably farther to the northward may be considered perhaps as certain ; but in the absence of precise and conclusive observations of the nature above alluded to, we can hardly be permitted to speculate respecting the extent to which it may have reached. If the elevations assigned to the northern parts of the plain of Hindostan be correct, a rise of 800 or 1000 feet in the ocean's level would insulate nearly the Deccan and Peninsula, bringing the waves to the foot of the mountain barrier of the Himalayah.*

In cutting a new well 50 feet deep in the cantonment at Rewarrie, where hardly any water can be found, except in one or two places free from salt, the following appearances occurred:

8 Feet.—Of vegetable mould.

7 Feet.—The alluvial deposit known by the name of Kunkur all over India, consists of small oblong indurated pieces of limestone, of a dark colour, cemented by a calcareous clay nearly white, both almost entirely soluble in acids. By the action of air and of rain, some part of this clayey cement is washed away, leaving a hard honey-combed surface not easily separated.

26 Feet.—A calcareous clayey mixture of light yellowish red, effervescing strongly with acids; the upper part of the bed contains numerous masses of compact limestone of a flattened cylindrical shape, growing larger and less numerous towards the lower part of the bed, where they are sometimes eight inches or a foot long, three or four inches in diameter. They seem in general to lie horizontally, the surface honeycombed and covered with the whitish clay, but the ends naked, presenting the internal surface of dark compact limestone as in a fresh fracture; as these become larger, the quantity of calcareous matter in the bed seems to diminish as if they were increasing by accretion of calcareous particles at the ends. They are entirely soluble nearly in acids.

9 Feet.—Becoming more clayey and moist, only slight ef-

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* The analogy in physical characters between the plain of lower Egypt and the districts here described, in alluvial calcareous stratification, sandy plains, and salt lakes, (in the one case the salt is soda, and in the other the muriate,) seems very strong. If the natron of the lakes of Egypt was originally deposited in the state of muriate, whence arises the decomposition in the one case and not in the other?

The occurrence of the *Asclepias gigantea* and *Rhamnus lotus* with much frequency in the African plains is mentioned by Mr. Park. I know not if the Hindostanee *Asclepias Syriaca* and *Zyziphus jujuba*, every where almost meeting the eye in the Gangetic plain, have been compared with them. If specifically distinct, they are vegetable forms at least *almost* the same, and the berries of the Rhamnus seem to be formed into bread in Africa as well as in India.

fervescence in distant points, water collects at about 50 feet, in a mixture of clay and sand of a light yellowish grey. No perceptible effervescence.

The slope of the Rewarrie plain is northward, towards which during the rains considerable streams flow, and are lost, it is said, in the sands.

The ranges of low rocky hills running from N. E. to S. W. generally, which here make their appearance, are said to commence a little to the northward of Honsi, and may be considered as the first outskirts of the group of the hills of the Deccan and peninsula.

They are here commonly composed of clay slate, of a bluish and greyish black, too decomposable, and of a structure too little crystalline to admit of its being ranked probably among the primary or primitive classes; it seems to rest upon a species of mica slate, however, and is pervaded in many places by veins, and contains very considerable beds of quartz rock, and pure white quartz.

In the vicinity of many of the veins the same alteration in the structure of the slate, waving and contortion of the laminæ, which have been noticed in similar rocks elsewhere, is very frequent. The highest summit in this vicinity which I have estimated, having then no other means of judging of it, at from 900 to 1000 feet above the plain, is composed of a very hard compact rock of a bluish-black colour, which appeared to me to agree in its characters with that to which the name of Lydian stone is given. On its slope flesh-coloured quartz rock, sometimes slaty in its structure, and in vertical layers, occurs sometimes spotted with large whitish maculæ, in it is contained a very rich ore of iron, and towards the lower parts of the bed where it reposes on the clay slate, are cavities containing sometimes pretty large and perfect rock crystals incrusting them. These hills are generally naked and barren of trees, except stunted mimosæ, *Barleria prionitis* and Justicia, the *Caparis heteroclita* may also be found among them, a scandent species:

The Salvadora persica.
Mimosæ seerissa.
—— Farnesiaca.
—— Arabica.

The Mimosæ Catechu.
Æschynomene grandiflora.
Nauclea.
Meliæ.
Butea frondosa.
Clerodendron Phlomoides.
Mimusops.
Cassia fistula.

The district, however, possesses few natural trees of great luxuriance, these being chiefly reared round the well-endowed residences of Hindoo mendicants, or the tombs of Mahomedan saints.

The most common bushes are the *Caparis aphylla* and a Gardenia, I think, *Dumetorum;* several species of *Zyzyphus,* and an *Indigofera.* The only species of *Spartium* I ever found in India was here. The voluble and delightfully fragrant Asclepias, or *Pergularia odoratissima,* spreads its rich and heavy perfume all around in the rainy months.

In no part of India are the hot winds more violent than here, they sometimes continue blowing during most part of the night—from the west, or a little to the north or south of that point, during April and May and part of June—every thing is in a state so parched and dry at this season, that conflagrations, where they occur among the thatched cottages of the natives, spread most extensively. The high state of positive electricity in which the bodies of all animals are at this season, cannot fail to produce, one would imagine, remarkable effects upon the state of their health. This place seems also subject, in a remarkable degree, to violent northwesters, darkening the air to a lurid red at noonday, and raising whirlwinds of sand from the deserts to the westward.

The rapidity with which verdure spreads itself over this dry, parched, and sandy region, as soon as the rains begin to fall, is astonishing.

The internal structure of the hills of the outward barrier of the Himalayah, is very distinctly seen, particularly in some of the passes into the Doon or valley of Deyrah. The Reet or Timley pass, (through which the heavy guns were taken during the campaign,) is one of the most remarkable in this respect. The pass, like most of the others, which however are generally on a smaller scale, is formed by the broad and winding bed of a water course, presenting, according to the season of the year at which it is viewed, a disturbed torrent filling great part of the breadth of its bed, or a clear and small stream shrunk up to occupy only the central portion of the vast flat surface of larger and smaller, rolled and water-worn stones, which are strewed profusely around. The summits, from 500 to 900 feet in elevation, are generally of the clayey, calcareous, alluvial deposition, well known all over India, which by the action of rain and air, and by the heat of the sun, hardens into cliffs, often presenting in miniature, the aspect and appearances assumed by more perfectly formed rock-formations. During the rainy months, when every tree in the surrounding forests is in a state of green luxuriance, more lovely scenes cannot be conceived than those formed by the amphitheatres, of which new varieties open to us as we advance, and our view is closed in by those behind, in winding up these gravelly passes, with lofty wooded eminences, precipitous steeps, and shady ravines opening on either side. The gigantic scandent bauhinia, the stem of which resembles a snake of the largest size, twines round the trunks of the trees, often hanging its festoons over us from their loftiest branches, bearing its large woody siliquae or flowers which mingle their fragrance with that of the mimosae. Numerous species of *Arum Orchidaeae*, *Curcuma* and *Amomum*, the roots of which have remained inactive and unobserved during the cold and dry seasons, now show their flowers and foliage tempting the unwary admirer of nature, by the smiling aspect of all around, to linger in these unhealthy spots, where scarcely any native of the country can remain for a week or two, particularly passing the night, without an attack of remittent fever. As the first tendency to these attacks displays itself in disorders of the digestive functions, it has produced a belief among the people, otherwise at a loss to account for the diseases to which they are here subject, that the water by its unwholesome qualities, acts a much more important part in their production, than is probably the case.

The stratification of the interior of these eminences, where it is often displayed in mural precipices, is almost always the same, consisting of layers of different thickness, dipping a little to the northward or southward of east, most commonly the former, and at angles of from thirty to forty degrees. These are generally of a gravelly deposit, studded with the same water-worn rounded stones, which strew the river bed alternating with the strata of an imperfectly formed sandstone, so friable as to crumble under the pressure of the fingers. The steep natural faces of the cliffs commonly point towards the plains; while towards the Doon, the ground slopes with a gentle declivity and deep soil, covered with Sal forest. From this quarter no cliffs almost can be seen; the general level of the Doon too, is considerably elevated above that of the plains in front of the hilly barrier; and here we may observe is the first indication of a law which seems to prevail very generally over all the hilly country under consideration, without excepting perhaps the snowy range itself, and the valley of the Sutluj on its north-east face, viz. the dip of the stratification in a north-easterly direction, giving the best surface and moisture for the nourishment of trees, which, most frequently, generally speaking, are numerous and large on that face, or the north-west sometimes. Some other speculations can hardly fail to be suggested by the circumstances under which the rolled stones occur in the stratification of the pass, 1*st*, From the uniform thickness of the same strata, and the distribution of its rolled masses, we can hardly fail to conclude that they were originally deposited in a horizontal position, and that they acquired their elevation towards the plains, or their dip towards the line of the hills, by some subsequent change.* 2*dly*, The rolled stones in the river's bed are many of them the debris of those beds a second time disintegrated. 3*d*, The rolled masses themselves are fragments of rocks only found in the mountains of the interior. In their original situation some of them appear to be the compact almost crystalline limestone of an interior range, which is almost entirely soluble in acids, and is now collected from among the other debris, by those in the habit of distinguishing the stone, in order to furnish the purest lime for building. Among these summits the *Pinus longifolia* of Dr. Roxburgh, the sp. of lowest level, first makes its appearance, though the trees are greatly diminished in number since the first entrance of Europeans into the hills. The most common genera of trees are the *Mimosæ sirissa*, *Catechu*, and several other species.

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* Although styled alluvial, therefore, these hills may be considered as belonging to the oldest of the depositions into which the class has of late been divided by Mr. Buckland.

Several species of
Gardenia
Pterocarpus
Eugenia
Erythrina
Bombax
Cedrela
Bauhinia
Pyrus, 1 sp.

Bignonia Indica
suaveolens
suberosa?
Semicarpus anacardium
Echites antidysenterica
Casearea tomentosa
Murraya exotica
Prunus puddum
1.

Of shrubs the *Grislea tomentosa.*

Different species of *Zyzyphus* and *Carissa.*

The *Combretum ovalifolium* is to be found in the plains outside of the pass.

Sal forest *(Shorea robusta)* clothes both sides of the range, but in the pass there are few trees of that valuable species of timber tree to be seen. The valuable Sissoo *(Dalbergia sissoo)* affects moist situations in the Doon, where the lofty grass jungle again covers great part of the face of the country. The *Siphonanthus*, or *Ovieda verticillata*, is of frequent occurrence about Senspoor, forming another vegetable feature of the grass jungle in the Doon.

From Senspoor we proceed to cross the river Jumna, into the smaller valley or Doon, called Kerda, from the name of a small village in it, forming a route very frequently adopted in entering the hills. Where the river cuts the range above Padshahmuhul, the jungle is too thick to admit of a passage along its banks, although difficult footpaths may be found, at the hazard of being devoured by wild animals.

This valley has been almost entirely abandoned to jungle, being chiefly visited by woodcutters and preparers of the *Cut* or *Catechu*, from the *Mimosa* furnishing it. Tradition however represents it as having been less thinly peopled in former days. Its superior unhealthiness to the valley of Deyrah probably arises from its narrowness, and being more completely shut in by mountains and hills in the direction of the prevailing winds.

Among the wooded heights in the ascent from this valley to the town of Nahn, besides most of the trees noticed before, we find the *Nerium odorum* occupying most of the stony water courses, several species of *Dyospyros*, the formed wood of one of which is said to be ebony. The *Rottlera tinctoria*, and a tree seemingly a species of *Conocarpus*, known by the name of *Tsal*, seem to be peculiar to this belt of elevation. The

Gmelina arborea
Garuga pinnata
Limonia crenulata
Solanum pubescens

are common trees and shrubs.

The most common scandent plants are the

Hastyngia coccinea
Echites dichotoma
Gærtnera racemosa
Menispermum verrucosum
Smilax ovalifolia.

Nahn is reckoned upwards of 3000 feet above the level of the sea; 3207 according to Captain Hodgson, commanding a fine view of the plains of Hindostan. A valuable belt of bamboos occupies a space extending to about 1000 feet below the level of the town, a plant of which we here take leave, until we again meet a species occupying a very high elevation indeed, on the slope of some of the mica slate mountains. The *Pinus longifolia* assumes its greatest perfection on the summit of this range. The town is situated on the summit of a range of compact sandstone hills, of which the rock, though differing in its hardness, and the aggregation of its particles, yet resembles in its dip and direction, that of the alluvial strata formerly mentioned. The face of the hill, and the space between it and the plains, is filled up by a formation perfectly similar in many respects to that of Timley, a continuation indeed of the same. Where the sandstone investing the sides of this is laid bare, in the beds of streams about 1000 or 800 feet below the town, considerable quantities of carbonaceous matter are to be found in it, some of it perfect coal, but in small quantity, and much pervaded by silicious matter.

Here I first noticed the custom which has been frequently observed to prevail in these districts, of laying the children to sleep, apparently much to their satisfaction, at the commencing heats, and until the rainy season begins, with their heads under little rills of the coldest water, directed upon them for some hours during the hottest part of the day. Here it was practised in the case of a life no less precious than that of the young Rajah of Sirmoor, a boy about 10 or 12 years of age,—a sufficient evidence of the estimation in which the practice is held. It is most commonly, however, followed in the case of infants at the breast. The temperature of the water I have observed to be from 46° to 56° and 65°, and have only to add, that it seemed to me most common in those districts which, having a good deal of cold weather, are nevertheless subject to very considerable summer heats. It was a great preservative, the people affirmed, against bilious fever, and affections of the spleen, during the subsequent rainy months. Does it act in this way—(for of the fact of its utility I have no doubt) from the sympathy subsisting between the brain and the hepatic system? and if so, may we not expect to derive some advantage from its adoption in the medical practice of the plains, particularly among European children who suffer so much from these diseases? The want of the facilities enjoyed in the hills for its application, seems to be the chief objection. Might it not even be sometimes practised as a preventive in the case of adults? The violent attacks of congestive fever with hepatic affection which result to newly arrived Europeans, from exposure of the head to the direct rays of the sun, seem to complete the evidence respecting the mode of its operation, by pointing out the consequences of a converse mode of treatment.* Hitherto the agriculture and native vegetable productions have differed but little from those of the northern part of the plains of Hindostan—when we descend the north-east face of the Nahn range, to ascend the Jeituk or Dhartee range, the scene begins to change more remarkably. We take leave of the *Croton*, used for fences at Nahn, and of the *Euphorbia*, of arboreous girth, of which numerous plants, resembling Candelabra, occupy the interstices of the Nahn sandstone. The cultivation of ginger, turmeric, and arum, occupy richly manured artificial flats, where copious irrigation can be most easily applied at the foot of the Dhartee.

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* Hence perhaps one of the advantages in resisting the daily influence of climate tending to the production of chronic disease, enjoyed by the native over the European inhabitant of Hindostan. The turbaned and shaven head of the latter admitting of the ready and frequent access of cold water, forms a part of Eastern costume too widely extended, and immemorially used, among the most civilized inhabitants of the tropics, (whose fashions are neither adopted, nor pass away arbitrarily, as ours do,) to have been originally adopted without reason, or perhaps now neglected with impunity by us, when residing permanently among them.

This range contains elevations of from 4000 to 5600 feet above the level of the sea, and consists principally of a rock nearly allied in character to the Nahn sandstone, but considerably more compact and indurated; it is of a light bluish grey, sometimes with maculæ of a dark purple,—the hills, however, have altogether a different outline, and stratification is often hardly perceptible. Towards the foot of the range, and at some parts of the summit, either the same mineral acquires a slaty structure, or rests upon a variety of clay slate—the strata of which are frequently nearly vertical, but generally with an inclination in the usual direction.

The summits are occasionally capped with sandstone beds of small extent, and also, I believe, with limestone of an earthy fracture, though the latter I have not seen. Large accumulations of a highly indurated reddish clay occupy many places on the north-east face of the range. The mineral, I rather think, is grey wacke, and grey wacke slate, or perhaps resting upon clay slate.

The prevailing vegetable productions are now almost entirely changed,—the range is generally little wooded,—the patches of *Pinus longifolia*—(native name, Cheer)—and Ban, the Quercus of lowest elevation, occupy chiefly the north-east and north-west faces.

The *Andromeda ovalifolia*—(Dr. Wallich.)
Simplocos racemosa,
Morus serrata,
Xanthoxylon alatum,

are common, as well as several arboreous *Urticææ*, the *Seharoo*, and *Beeool*, the latter *Grewia*, a trifoliated species of Rhus, the species of lowest level here first makes its appearance.

The *Rhododendron puniceum*, and *Pinus deodara*, or Indian larch occur but rarely as yet, except in the highest summits. Different species of Galium, the *Rubia munjeet, Hypericum cernuum, Berberis angustifòlia, Cratægus integrifòlia;* the *Salvia lanata, Androsace cordifòlia*, and the first species of *Delphinium.* The mango ripens nowhere higher than Nahn, although trees of it may be seen a few hundred feet below the summit of the range, which have been reared with care. One species of *Olea* is also found here indigenous, a fine umbrageous tree, but the fruit is small and of no use. At this level, or perhaps a little higher, I hope the European, a much more valuable species, may ultimately be introduced.

Descending the north-east face of the *Jeituk* or *Darthee* range into the bed of the river Julall, we pass over a series of undulating heights, which give to the range viewed from this face a much more rounded and less steep aspect than viewed from the plains it bears. These are often formed by the red indurated clay before mentioned, and in banks of this the bed of the Julall is often deeply cut. Crossing this river we ascend the *Sein* range, the massive contour and more equable elevation of which marks it as formed of a mineral we have not yet had occasion to notice; the whitish appearance of the cliffs, which occasionally display themselves only near the very summits, in the rains beautifully contrasted with the green of a fine pasturage, for which this range seems more favourable than the former, leads even a superficial observer to expect limestone; and the similarity between the external aspect of the range and those I have seen depicted, formed of the same material, in many drawings of Grecian scenery, immediately occurred to me.

The vegetable character of this range does not differ very remarkably from that of the last mentioned; the loftiest summit in it is perhaps *Krol*, stated by Captain Hodgson at 7812 feet above the level of the sea. It has, however, certain plants peculiar to it, and many of those which are rare, or only beginning to appear on the former, are here in their highest luxuriance. The hot wind of the plains, greatly abated in violence from the shelter given by that in front, affects considerably the temperature of the range during April, May, and part of June, when they prevail.

It appears at a distance to be almost destitute of trees, but in many of the dells and northerly faces it is well wooded with the *Pinus deodara* and *longifolia*, besides the species of Quercus, called *Ban* by the natives, formerly mentioned. A second evergreen species of oak, bearing the name of *Mohroo*, becomes common. Here, and more remarkably at similar elevations in the ranges interior to this, many of our fruits common in Europe come to considerable perfection in their natural state, and by the introduction of European modes of culture and engrafting, I feel confident that ultimately great improvement may be effected in many of these, as the apple, pear, apricot, peach, plumb, walnut, raspberry, strawberry, &c. &c. Even the fruit of the *Prunus puddum*, which in warmer belts of elevation is useless, becomes here an eatable cherry. *Begoniæ*, *potentillæ*, and a great variety of orchideous plants here show themselves during the rains, particularly the orchis or *Habenaria gigantea* and *pectinata*, described by Dr. Buchanan in the Flora Exotica I believe. The *Roscoea purpurea* becomes here common; a species of daphne also begins to appear, that from the roots of which paper is made; a species of parnassia may also be found; and confined to rather a narrow belt at about this elevation, the small tree furnishing the fruit called *Kaeyphul*, mentioned by General Hardwicke in his Serinugur tour, but the genus of which, from never having seen it in flower, I am unable to fix.

ART. V. — *Description of the First Steam-Engine.* Communicated by the Author.

OF all those whose names are associated with the history of the steam-engine in its first stages, the Marquis of Worcester, who lived in the reign of Charles II. is by far the most renowned. A book was published by the Marquis himself in 1663, under the title of "*A Century of the Names and Scantlings of such Inventions as at present I can call to mind to have tried and perfected, (which my former notes being lost,) I have, at the instance of a powerful friend, endeavoured now, in the year* 1655, *to set these down in such a way as may sufficiently instruct me to put any of them in practice.*"

When considered as a description or index of the discoveries and inventions of one individual, it is certainly one of the most extraordinary scientific productions which has yet issued from the press in any age or nation.

The 68th article in this book is that on which rests his claim to the honour of having invented the steam-engine. It is in these words;

"An admirable and most forcible way to drive up water by fire; not by drawing or sucking it upwards, for that must be, as the philosopher calleth it, *intra sphæram activitatis*, which is but at such a distance. But this way hath no bounder if the vessels be strong enough; for I have taken a piece of a whole cannon, whereof the end was burst, and filling it three quarters full of water, stopping and screwing up the broken end, as also the touch-hole; and making a constant fire under it, within twenty-four hours it burst, and made a great crack; so that having a way to make my vessels, so that they are strengthened by the force within them, and the one to fill after the other, I have seen the water run like a constant fountain stream forty foot high. One vessel of water rarefied by fire, driveth up forty of cold water; and a man that tends the work is but to turn two cocks, that one vessel of water being consumed, another begins to force and re-fill with cold water, and so successively, the fire being tended and kept constant, which the self same person may likewise abundantly perform in the interim, between the necessity of turning the said cocks."

Not having met with any design or drawing of a steam-engine to which the above appears applicable, but in place of that, having seen it doubted by some, and denied by others, that any engine can be constructed exactly upon these principles, the following description and sketch are submitted to the consideration of the readers of the Edinburgh Journal of Science.

In Plate II. Fig. 3. A represents a boiler placed in a common air furnace; *a b c d*, and *e f g h*, two water vessels; *i k l* the steam pipes, and *k* the steam cock; *x x x x* the force pipe; RS a cistern, which may be supposed to be placed at the height of forty feet above the engine, to receive the water from the force pipe; and *v v* valves placed within the force pipe to prevent the return of the water; *m n o* the cold water pipes, and *n* the cold water cock; the dotted lines *b z e* represent the cold water fountain, which is here supposed to be immediately behind the engine, and the water in it standing nearly upon a level with the top of the cold water vessels. Fig. A. is a ground-plan of the fountain, where *m n o* represent the cold water pipes, *n* the water cock, and F the reservoir. Fig. 3. represents a section of the two cocks, which are in every respect similar; the black circle *a b c* represents the key of the cock, and the black shaded part the passage through the key; the dotted circle *r s t u* the shell or body of the cock, the two dotted lines *t z* the pipe that leads from the boiler, the two dotted lines *s z* the pipe that leads to the right hand water vessel, the two dotted lines *z u* the pipe that leads to the left hand water vessel, and the curved dotted line *x z y* the top of the boiler.

From an inspection of Fig. B. it will appear, that by a quarter turn of the key of the cock *k*, (Fig. 1.) the steam may either be directed into the right or left hand water vessel, and, in like manner, by a quarter turn of the key of the cock *n*, cold water may be permitted to pass into either of the vessels.

Suppose the fire burning, and the boiler sending forth steam, and the key of the cock *k* turned so as to permit the steam to enter into the vessel *a b c d*, then will the steam drive out all the air of that vessel up the force pipe *x x x x*, and occupy its place, steam will then be seen to issue from the nosel *w* of the force pipe. When this is observed, the key of the steam cock *k* must be turned, to permit the steam to pass into the vessel *e f g h*, and, at the same time, the key of the cold water cock *n* must be also turned, to permit the water from the fountain to be forced into the vessel *a b c d*, (by the pressure of the atmosphere,) as the steam therein condenses with the cold water; and when the vessel *a b c d* is filled with water, and the vessel *e f g h* with steam, the key of the steam cock *k* is to be turned back into its first position, which will again permit the steam to pass into the vessel *a b c d*, to act upon the surface of the water in that vessel, so as to drive it up the force pipe *x x x*, and, at the same time, the key of the cold water cock *n* must also be turned, to permit the cold water to condense the steam and fill the vessel *e f g h*, and which will also be forced into this vessel, (by the pressure of the atmosphere,) to occupy the vacuum effected by the condensed steam. The cock *n* is next to be turned so as to permit the vessel *a b c d* " to force and re-fill with cold water," and, at the same time, the steam cock *k* is to be turned, so as to permit the steam to act upon the surface of the water in the vessel *efgh*, and so on alternately, producing a constant stream from the top of the force pipe. The boiler may be supplied with water from the cistern RS, by means of a small pipe and stop cock.

To produce " a constant stream forty foot high, one vessel of water rarefied by fire, driveth up forty of cold water, (or in other words, forty times the quantity in the boiler.) A man that tends the work is but to turn two cocks, that one vessel of water being consumed, another begins to force and re-fill with cold water, (by the pressure of the atmosphere,) and so successively, the fire being tended and kept constant, which the self same person may likewise abundantly perform in the interim between the necessity of turning the said cocks."

Although the Marquis of Worcester has only proposed to force water by his engine to a great height, yet it appears that he knew that water could have been brought up from a limited depth by suction, (by the pressure of the atmosphere into a vacuum); for the 68th article commences with these words: " An admirable and most forcible way to drive up water by fire, not by drawing nor sucking it upwards, for that must be as the philosopher calleth it, *intra sphæram activitatis*, (within its sphere of activity,) which is but at such a distance."

It is therefore very obvious that the Marquis had a knowledge to what height water could have been raised from the effects of a vacuum, and which he had put a small value upon in comparison of what he had in view; for he adds, " But this way hath no bounder if the vessels be strong enough." The Marquis a little further on says, " So that having a way to make my vessels, so that they are strengthened by the force within them."

This can only apply to strengthening his boiler and vessels by riveting radiating arms inside of them, and making them in other respects strong.

Mr. Thomas Savery's engines were made, (to use the Marquis of Worcester's words,) both to suck and force, as appears from an engraving of Savery's engine in Harris's Lexicon Technicum, which has what is there called a sucking pipe, as also a forcing pipe. It has two boilers, a larger and smaller one, and two water vessels, there called receivers. The small boiler is supplied with cold water by a branch pipe from the forcing pipe, and the large boiler is supplied with hot water from the small one. The steam, after entering the receivers, is condensed by water falling from a cold water pipe on the outside of the receivers.

By the Marquis of Worcester's engine not having a suction pipe, the steam in his water vessels is condensed by permitting the cold water from the fountain to refill them alternately.

The great waste of steam in these engines, occasioned by its coming in contact with the surface of the cold water in the receivers, led to the following devices to prevent that waste.

First, That of introducing a surface of oil upon the water.

Secondly, That of introducing a column of air between the steam and the water.

Third, That of introducing a floating piston between the steam and the water; and,

Lastly, The introduction of steam-tight pistons.

From what has been stated, it must appear obvious, that the Marquis of Worcester had the honour of being the inventor of the steam-engine, and that Mr. Savery had the merit of being the first that brought it to be so far practicably useful. But it was to a Mr. Thomas Newcomen that the mining interest was first indebted for making it serviceable in the draining of mines. (See Switzer's *Hydrostatics*.)

With regard to the experiment of bursting the cannon mentioned in the same article, this will appear quite practicable, if we take into account the time that the cannon was kept in the fire, which was much longer than sufficient to have melted it down, had the fire been suitable for that purpose; it must, however, have been a great fire, as it would have been attended with much danger to supply it with fresh fuel. It is, therefore, reasonable to suppose, that from this great heat, there would arise a continual increase of the expansive force of the steam, and a continued decrease of the strength of the metal of the cannon, until the strength of the cannon became unequal to the expansive strength of the steam, and, in consequence thereof the cannon would give way and make "a great crack."

Prior to the date of the Marquis of Worcester's book, one Branca, an Italian, applied the force of steam from a large Æolopyle upon the vanes of a wheel, somewhat like those of a horizontal wind-mill, so early as 1629. But in no way could this manner of applying steam be transferred, or lead to the construction of any one part of the Marquis of Worcester's steam-engine, of Mr. Savery's, or of any other that is entitled to the name of a steam-engine.

The writer of this article, about thirty years ago, fitted up a boat, or rather a canoe, to be wrought by spiral oars made of sheet-copper; but as the canoe was not of sufficient dimensions to carry a person to work the oars, they were wrought by means of a copper Æolopyle, placed on a fire-grate within the canoe, that ejected steam against the vanes of a horizontal wheel made of tinplate, and which communicated motion to the spiral oars.

At the time when the above experiments were made, the writer of this had no knowledge of a similar experiment having ever been made with the Æolopyle; he first met with an account of Branca's application of steam in the first edition of Gregory's Mechanics, published in 1807.

The Æolopyle experiment was an unprofitable waste of steam, and could show but little of the effects of it; whereas, that of the bursting the cannon was a great first experiment.

A. S. O.

September 30, 1824.

ART. VI.—*On a Method of Splitting Rocks by Fire.* By JOHN MACCULLOCH, M. D. F. R. S. F. L. S. and M. G. S. Chemist to the Board of Ordnance, and Professor of Chemistry in Addiscombe College. Communicated by the Author.

MANY large tracts of the mountainous land of Scotland, which possess an excellent soil capable of cultivation, are incumbered by huge alluvial or detached blocks of stone; and the expense of removing these from the surface forms, in many cases, nearly the whole difficulty which stands in the way of their improvement. Where dikes, or stone-walls are required to enclose such land, the expense of thus clearing the soil is materially diminished by the countervailing value of the quarry which the field itself thus affords. But even in these cases, where the blocks are too large to be weighed and removed entire, a considerable expense is incurred by the necessity of blasting them by gunpowder until they are reduced to a portable dimension. This, however, is the practice almost universally resorted to in Scotland; and every where, I believe, throughout Britain, where this kind of improvement is carried on.

In making the Highland roads also, where it is generally necessary to provide a quantity of stone for the masonry required in supporting the lower side of the road, in fortifying the upper bank, and in the construction of drains and bridges, it is usual to have recourse to such blocks, wherever the road itself is not carried through rocks in such a manner as to produce the necessary quantity of materials. In this case also, the process of blasting is adopted, as it necessarily is, whenever solid rocks are to be cut down or levelled.

This process is both tedious and expensive, but the price, of course, varies with the wages of labour in different places. Where I am writing it is now 2d. per inch, and, according to the dimensions or nature of the rock to be split, the mine varies from eighteen inches to two feet in depth, or, exclusive of the expense of gunpowder, the cost of this mine or blast hole will range from 3s. to 4s. It will be a very moderate calculation to estimate twelve inches for one mine, or 2s.

for every large stone; and in most parts of the Highlands, or of Scotland in general, this is nearly a day's labour for a man, on account of the time expended in coming to the ground and in returning. To this expense, however, must be added, not only the price of the gunpowder, but that of sharpening the gads, which is considerable, and the other wear and tear of tools. I cannot here procure an exact estimate of these expenses, nor is it material, as it will easily be calculated by all those who have an interest in doing so, or have such work in hand. I need only add, that as, in many cases, the quantity of such stones on ground otherwise fit for cultivation is enormous, it is material to find out the means of diminishing an expense which may exceed the fee-simple of the land when cleared. The same reasoning applies to the Highland roads, which, from their expensive construction, trench so deeply on the funds provided for them, that nothing remains to replace the accidents arising from torrents or other causes, or for the purposes of ordinary repairs.

The contractor for a road from Loch Ewe to Gerloch, who resides at this place, finding it difficult to carry on his work at the contract price, has abandoned the process of blasting, and has had recourse to fire alone; and in this way he has now conducted his road for some miles with a great saving both of time and labour. Whether he has had any precursor, except Hannibal, in this practice, I know not, as I have not found it in use elsewhere in any part of Scotland; but he appears at any rate to have the merit of an original inventor, as he had heard neither of any predecessor nor rival in his art.

In conducting the process, a fire of peat is made on the surface of the stone, and being then secured at the margin by stones and turf, it is kept in activity for five or six hours. At the beginning of his career, when the fire was extinguished, Mr. Mackenzie was in the habit of throwing water on the rock, which was then found to open in different places, in such a manner as easily to admit a wedge or two, and thus to be split by a few blows of the sledge. But finding, in some situations, that it was difficult to procure water, and that the expense was thus materially increased, he abandoned this part of the process, and now finds that the stone, on cooling, is equally fissured, and equally admits the wedge.

On examining the nature of the rocks submitted to this process, I doubted its efficacy, and was only convinced by witnessing the effects. They consisted of the roughest variety of gneiss; that kind which is composed, in a great degree, of compact felspar, and of varieties equally tough and refractory, of hornblende rock or hornblende schist. Nor could any fissures be discovered in the blocks before the action of the fire, by which, if not produced, they were at least enlarged from a state previously invisible. As these are the only rocks which this part of the country affords, I cannot say whether the same effects would be found to take place in all, more particularly in granite. It is probable, however, that every rock is equally susceptible of being split by the same cause; as there are none in nature more compact and more apparently free from flaws, than those in which the process succeeded at Loch Ewe.

It is easy to understand how the effect is produced, as it is in glass, by the unequal expansion of the parts, even without the assistance of water; and it is equally easy to comprehend how a fire of only three or four feet in diameter is thus capable of acting on a stone of many tons in weight.

It is probable that the quantity of fire, as well as its duration, must be made to vary with the dimensions of the block to be split; but, in all the instances which he had attempted, he had not at this time experienced a single failure, though a very considerable number of rocks had been removed in conducting the road for a space of about five miles.

At the place in question, the peat was every where at hand, and required scarcely any expense of carriage; none other, in short, but that of being cut and cast in readiness for use whenever it was wanted. Wherever it may require a distant carriage in addition to that, it is evident that the charge will be augmented. In Highland road-making, peat is rarely far off; and, indeed, when it is not at hand, the same purpose may be served by the heath and turf, which is every where present, and of which a great quantity is necessarily removed in lining out the road. In clearing land in the Highlands, the same reasoning applies, as, either peat is seldom far distant, or the land itself furnishes brush-wood and weeds. These are often burnt for no other purpose than that of destroying them, and procuring the ashes and burnt earth attached, which are found to form an useful manure; while by making this use of them the same produce would be obtained in addition to the other advantages.

In clearing land by this process, it would be necessary to form previous deposits of fuel in convenient parts of the field, that no impediment might take place during the process of firing, but that all the labour required for the several parts of the work, may, at one time, be directed to one object only. Thus the labour which, during one period, has been expended in distributing the fuel, will, in the second, be engaged in firing the stones; and, in the third, in splitting them by the wedge, when they will be ready for removal, either by the plug and gin, or by the more common proceedings.

It will be seen that, in this case, the great saving of labour takes place in the firing, as one man can attend a considerable number of fires over a large space, and thus, in a single day, prepare an extensive tract for the hammer and wedge. Thus, it is calculated, that the firing and the previous labour of collecting fuel will not exceed the price of tools and gunpowder, and the comparison will then remain between the time or labour required to bore so many mines, or to split the blocks by the wedge. These are data easily ascertained with very little attention; and if, on more extended trials, the balance in favour of the method used at Loch Ewe shall be found to correspond elsewhere, as it has there done, it will be found a valuable acquisition both to road-makers and to improvers of rough land in the Highlands.

It remains to be ascertained to what extent the same practice is capable of being applied in splitting solid rocks, no necessity for this having occurred at the place in question.

It is evident that it will, in this case, be limited in many places, by the form of the rock, as the fire cannot often be effectually applied except to a horizontal surface. But, doubtless, many cases will occur where this practice can be brought into use with economy.

Art. VII.—*An Account of the Frontier between Part of Bengal and the Kingdom of Ava.* By Francis Hamilton, M.D. F.R.S. and F.A.S. Lond. & Ed. Communicated by the Author.

Between Bengal and the kingdom of Ava there are three principal routes by land: 1*st*, through Asam; 2*d*, through Kashar and Munipura; and 3*d*, by Arakan, passing the boundary at the river Naaf. In the second part of *The Annals of Oriental Literature*, while treating of Asam, I have given some account of the first two routes, and of the countries situated between the northern parts of Bengal and the dominions of the king of Ava. It is now my intention to mention some particulars concerning the countries which are situated between this kingdom and the southern parts of Bengal, including the districts of Tiperah (Tripura) and Chatigang.

Both these districts at one time seem to have belonged to the Rajas of Tripura, who are celebrated in the ancient Hindu traditions for their luxury; and on the Minamati hills, called Lolmi by Rennel, the situation of their ancient abode may be traced for a great extent, about six miles west from Komila. I travelled there, through the remains of brick buildings, for about a mile and a half. At the northern end of this ruin are the remains of a fort about 200 yards square; and a mile south from thence are four or five steep hills composed almost entirely of brick, and connected and surrounded by ditches, which seem to point out the royal residence.

These princes seem to have been early attacked by the kings of Bengal, whose Mohammedan subjects then seized a large part of the country, leaving, however, the Tripura princes in possession of large estates as tributaries, while the more inaccessible parts of the country continued independent, and occupied by the aboriginal inhabitants, who use languages totally different from the Bengalese. The Mohammedans of Bengal were, in their turn, worsted by the kings of Arakan, (Rakhain,) who conquered the whole country near the sea, and were not driven out until after the accession of the house of Timour; nor have the Tripura Rajas recovered any part of this southern portion of their ancient dominions; although, in several parts among the hills of Chatigung there are remnants of this tribe. I shall, for the present, content myself with an account of that part of the frontier where the Tripuras still retain some sort of independence, or claim a supremacy.

In 1798 Radun Manik, the Rajah of Tripura, resided at Agatola, near Komila, his whole estates on the plains having been long tributary and subject to the government of Bengal; but the Tripura nation, or tribe, maintained, under his authority, a kind of independence among the hills for about thirty miles in width, along the banks of the Monu river, which falls into the Surma, and along both banks of the Gomuti and Phani (Fenny R.) rivers, a length of about 120 miles.

The Tripuras seem to be divided into three tribes: 1*st*, The Tripuras, properly so called, who occupy the banks of the Gomuti; 2*dly*, the Alinagar, who occupy the banks of the Phani, and especially of its principal branch the Muri, which passes Kundal; but a part of this tribe occupies the banks of the Alta, a branch of the Karnaphuli, which is included in the district of Chatigang; and 3*dly*, the Reang, who occupy chiefly the banks of the Monu, which falls into the Surma. All the Tripuras are by the Bengalese commonly called Teura. It was with the southern tribe alone that I had any intercourse, and these did not call themselves Tripuras but Baruksa, the final *sa* being analogous to the English word men, when speaking of nations, as Frenchmen, Irishmen, Scotchmen; so that Baruk is the name of this tribe at least; whether it is applicable to the whole Tripura nation I cannot say, but I was assured by the Raja's principal officer, (Dewan) that all the three tribes of Tripuras speak the same language, although this varies into several dialects, as usual among all people having no literary standard. These tribes indeed, the Dewan says, are mere local distinctions. I took down some of the most common words from those who inhabit the banks of the Karnaphuli, and on comparing them with those used near the Phani, I found some differences; but this may have

arisen from misapprehension. The following are the words which I took down:

1. Sun, *sal.* 2. Moon, *tal,* or in the dialect of the Phani, *hando kree.* 3. Star, *hando goorua.* 4. Earth, *ha.* 5. Water, *tei.* 6. Fire, *hor.* 7. Stone, *holoong.* 8. Wind, *nobar.* 9. Rain, *yatei,* or in the Phani dialect, *watei.* 10. Man, *broo.* 11. Woman, *bree,* or in the Phani dialect, *brui.* 12. Head, *bokroo.* 13. Mouth, *bokook,* or in the Phani dialect, *kowk;* from which we may perhaps infer that the *bo* prefixed to this and the preceding word is the mark of some inflection. 14. Arm, *yauk,* or in the Phani dialect *yauktauk.* 15. Hand, *yaukgora.* 16. Leg, *yatee,* or in the Phani dialect *yapatoe.* 17. Foot, *yapalei.* 18. Bird, *tauksa.* 19. Fish, *aw.* 20. Good, *hamo.* 21. Bad, *hamya.* 22. Great, *godja.* 23. Little, *goorua.* 24. Long, *lawo,* or in the Phani dialect *kalow.* 25. Short, *bara.* 26. One, *kaisha.* 27. Two, *konoi.* 28. Three, *kotam.* 29. Four, *boroi.* 30. Five, *ba.* 31. Six, *douk.* 32. Seven, *cheenee.* 33. Eight, *seeko.* 34. Nine, *chee.* 35. Ten, *cheenee.* This being the same with the word given for seven, there is probably some mistake. When these people have occasion to mention higher numbers than ten, they have recourse to the Bengalese language. 36. Eat, *chaday.* 37. Drink, *loungday.* 38. Sleep, *hogulday,* or in the Phani dialect *towanay.* 39. Walk, *baraweinay,* or in the Phani dialect *ookumfeelday.* 40. Stand, *basaday.* 41. Kill, *tanday.* 42. Yes, *oonglea.* 43. No, *korey.* 44. Here, *paidee.* 45. There, *oojan.* 46. Above, *tchowo.* 47. Below, *hasseco,* or in the Phani dialect *kamma.* From this it will appear that the Tripura language has no affinity with that of Hindustan, and very little with that of Ava. In one instance, indeed, the word *kree* (great) has evidently been introduced from the latter, the moon being called the great *hando,* and a star a little *(goorua) hando.* The word *cha* for eat is also the same with tsaw of the Ratahain dialect. *Day* or *nay* annexed to all the verbs is evidently the sign of the imperative, and is in use at Ava.

The Tripuras have features entirely like the Chinese or people of Ava, and have their huts built on posts like the latter, whose impure customs they follow, so that they must be

considered as of the same race, although their princes have adopted Hindu names and customs, and may very likely be of Hindu origin; but I did not learn their genealogy. It is probable, however, that both they, and a considerable portion of their subjects, who in former times cultivated the plains between the eastern hills and the Megna, came from Hindustan and settled among the Tripura nation, as from their buildings they evidently appear to have been a race much farther advanced in society. The mode of succession which prevails in the family may seem to militate against the Hindu origin of the Tripura Rajas. The Raja is not succeeded by his son, but by his nephew. In 1798 the Dhup Raja was considered as the heir apparent, although his father was then alive, and an older man than Radun Manik, who then was prince. A similar practice, however, prevails in Malabar; but then it is a sister's son who succeeds. The same indeed may be the case in Tripura; for at the time when I noted the nature of the succession, I was not aware of the nature of the succession through females used in Malabar, and the father of the Dhup Raja may not have belonged to the family; it may have been by his mother that he was nephew to Radun Manik.

The Tripuras cultivate what are called jooms, of which the following is the nature:—During the dry season, the people cut down to the root all the bushes growing on a sufficient extent of hilly land, that has a good soil. After drying for some time, the brushwood is set on fire, and by its means as much as possible of the large timber is destroyed; but if the trees are large, this part of the operation is seldom very successful. The whole surface of the ground is now covered with ashes, which soak into the soil with the first rain, and serve as a manure. No sooner has the ground been softened by the first showers of the season, than the cultivator begins to plant. To his girdle he fixes a small basket, containing a promiscuous mixture of the seeds of all the different plants raised in jooms. These plants are chiefly rice, cotton, capsicum, indigo, and different kinds of cucurbitaceous fruits. In one hand the cultivator then takes a dibble, pointed with iron, if this can be procured, and with this he makes small holes, at irregular distances; but in general about a foot from each other. Into each of these holes he with his other hand drops a few seeds, taken from the basket as chance directs, and leaves the farther rearing of the crop to nature; only he resides near, in a temporary hut, to drive away destructive animals, and to reap the crop as each kind ripens. Next year, in general, the cultivator selects another spot covered with wood; for in such a rude cultivation, the ashes are a manure necessary to render the soil productive, except in a few places peculiarly rich that bear a second crop. When the wood on a former joom has grown to a proper size, the cultivator again returns to it; and then there being few large trees standing, the operation of cutting is easier, and the ground is more perfectly cleared.

In this state of society, no tribe, whatever extent it may occupy, can make any considerable progress in the arts either of peace or war; and accordingly the Tripuras, subject to Radun Manik, are useless but harmless neighbours, along a frontier of about a degree and a half of latitude, and in a political sense are altogether insignificant.

The distance in a direct line east from Komila to the frontier of Ava Proper, near the river Khiænduæn, is rather more than 200 geographical miles. The Tripura tribe reach within a few miles of Komila, and extend about thirty miles to the eastward, while Taunduæn, the capital of the Aengiin subject to Ava, (*Phil. Journ.* iv. 83, vii. 232.) the nearest part of this kingdom, is from twenty to thirty miles in a direct line west from the Khiænduæn. As the territory of the Aengiin may reach twenty or thirty miles farther west than its capital, there is great reason to think that the space intervening between the Aengiin and the Tripura nation, will be somewhat above 100 geographical miles in width. No inquiries that I made either in Ava or Bengal, enabled me to ascertain that there was any passage entirely through this space. There perhaps intervenes a mountainous barrier, that has not been overcome, owing probably more to its ruggedness than to its great elevation; for mountains of an Alpine height are not visible from either side, which they could not fail to be were there any in so narrow a space. (See *Phil. Journ.* vii. 233.)

Towards the west, between the territory of the Tripura race and the central inaccessible mountains, there is a wide hilly region occupied by the people called Kungkis, mentioned in my account of Asam, (*Annals of Oriental Literature*, part iii. p. 264, and in the *Phil. Jour.* iv. 264.) as being the Langæh of the people of Ava, and the Lingta of the Bengalese. I have had no intercourse, nor farther information concerning the tribe of this race, which occupies the frontier towards the Surma, by which there is the most direct and important route between Bengal and Ava. Farther south, ten kinds of the Kungkis, who dwell about the heads of the Gomuti, are claimed as dependents by Radun Manik, the Tripura Raja; but his authority over them is probably very small; for his power is inconsiderable, and the Kungkis seem to be a warlike predatory people. They are, or at least in 1798 were, subject to a chief named Longshue, although I am not sure whether this name was that of the individual chief, or his title as head of the tribe; but I think that the last is most probably the case, as the people on the banks of the Karnaphuli, who were chiefly subject to the depredations of these Kungkis, called the tribe Lusai or Lushee, the same name, I suspect with Longshue: yet it must be confessed that the Dewan of Radun Manik spoke of the Lushee as being only one of the ten kinds of Kungkis dependent on his master. The dependance of this tribe, or of Longshue on the Tripura Raja is rather problematical, and the Lusai, are rather supposed by the people on the Karnaphuli to be subject to the tribe of Kungkis, called Bonzhu, or Bonjugy. In war, probably the two kindred tribes unite; but in peace, the Tripura Raja having the command of the commercial routes, may exert a kind of authority, and receive a toll or tribute.

I have not heard of any tribe that inhabits between the Longshue Kungkis and the great central ridge, the eastern side of which is occupied by the tribe, which the people of Ava call Khiæn, (*Phil. Journ.* ii. 263.); nor, as I have said, have I been able to trace any route across the ridge: yet I have some suspicion that a communication exists; for Longshue has a very great resemblance to Launsci, the name of a town on the east side of this ridge. (*Phil. Journ.* vii. 233.) This town, indeed, is inhabited by a tribe of the Mranma race called Jo, and between it and the ridge are interposed the Khiæn, totally different from the Kungkis; but it is not improbable that the town derives its name from being the mart for trade with the Longshue, of which origin of names I know several similar instances. It must also be observed, that another town of the Jo nation subject to Ava, is called Zbo, (*Phil. Journ.* vii. 234.) which is the same name with what some tribes at least of the Kungkis give to themselves, from which circumstance a similar conclusion may be inferred; but the language of the Jo, notwithstanding the resemblance of the names Jo and Zho, (*Phil. Journ.* vii. 235.) or Zhu, has no affinity to that of the Kungkis, being a mere provincial dialect of that spoken at Ava.

On a cluster of hills situated a little south from the tropic, and which, as I was informed, separates the waters falling into the Phani and Karnaphuli from those falling into the Gomuti, there is said to reside a tribe called Langmang, more rude than even the Kungkis, with whom they are at constant war. I have never seen any of them; but they are said by the Bengalese to sleep on trees like baboons. They do not cultivate rice, but live chiefly on the kind of grain called Kangun, (*Panicum Italicum.*) The latter circumstance is probable; but it can only be when they are watching their fields that these poor people can be supposed to sleep on trees, a rude stage placed among the branches, with a few leaves by way of thatch, being a kind of resting place, which I have seen used by watchmen in several places of India, where elephants abound, as they do on the hills near Kundal. It is probable that the Langmang are merely one of the tribes of Kungkis, of which Radun Maniks Dewan spoke; and there are many Kungkis both on the north and south of these hills.

These are the tribes interposed between Ava and Bengal, from about the latitude 24° 25′ to 22° 55′ N. I shall now give an account of the principal river by which this space is watered. It is properly called the Gomuti, which Major Rennell writes Gomut (Bengal Atlas, map 1,) or Goomty (Ibid. map 9,) and which seems to be derived from its crooked nature. I am persuaded, that by some mistake the rivers, which, in the 9th map of the Bengal Atlas, appear as the heads of the Chingree river, in fact belong to the Gomuti, the Chingree, or Chimay, as the natives call it, terminating, according to all the information received by me, at the hills on the south side of the tropic. The Gomuti, therefore, either passes through, or springs from the hills laid down in the above-mentioned map as the boundary of Ava, although I have reason to think, that the great central ridge is probably 20 or 30 miles farther to the east. Whether or not this space is altogether unoccupied, or whether it be inhabited by tribes subject to Ava, or by people that are altogether independent, I have not learned; but the last is probably the case; as farther south, this farther ridge, at the sources of the Karnaphuli, is peopled by an enterprising tribe of the Kungki race, and the same is probably the case at the sources of the Gomuti.

The hills lower down these rivers consist of clay and sand slightly indurated in thin plates, involving in some places small masses of a more solid nature, that admit of being cut with the chisel, and in a few places masses of petrified wood. In two places north from Islamabad there continually issues from chinks in these strata an inflammable gas, the burning of which has been successfully employed by some priests as a means of extracting gain from the superstitious. These hills rise to a considerable elevation, seldom exceeding 150 feet perpendicular, while the streams that run through the intermediate valleys or ravines have a very gentle current, and a sandy bottom; so that canoes can be pushed along to a great extent, especially in the rainy season. Unfortunately the country becomes then so unhealthy, that even the Bengalese do not venture to remain, but quit the hills with the first showers of summer. This prevented me from attempting to penetrate into the country of the Kungkis, as the rainy season had commenced when I was at Komila; and all the information that I can give concerning the route, is derived from the Bengalese wood-cutters, who are far from accurate. I shall here, however, mention what these people say, although it cannot be received as at all accurate in the details; but it will serve to show the nature of the country between Komila and what Rennell calls the Mugg mountains, a name totally unknown among such natives as I have consulted.

The wood-cutters state that February is the month best suited for penetrating with canoes through the country, which is then healthy; nor is there any want of water for bearing the canoes.

A canoe proceeding from Komila up the Gomuti takes two and a half pahars (seven and a half hours) to reach the mouth of the Kazi, a rivulet arising from a large marsh (jil) named Lodi, which, although nearly dry in the hot season, produces, in the rainy monsoon, an immense quantity of fish. The Kazi enters the Gomuti on the left going up, and its banks are inhabited by Kungkis. These marshes, or jils as they are called, are common among the low hills along the eastern frontier of Bengal. They occupy generally the greater part of the wider valleys winding among the low hills; and being perfectly level, are deeply covered with water during the rainy season, but have nothing like bog in their soil, which is in general excellent, and quite firm. The ground is so deeply inundated during the rainy season that it is unfit for the joom cultivation, and it is therefore neglected by the mountaineers. In some parts, indeed, stagnant pools or small lakes remain throughout the year; but in a large proportion the water dries up soon after the rains cease, and might be cultivated with the plough for winter crops. Indeed the water is in most parts so shallow, as to be well fitted for the cultivation of rice, and, by deepening the rivulets that pass through the extent of such land, might easily be increased, as has been done in many adjacent parts that are occupied by the Bengalese. This manner of cultivation, however, is not practised by the hill tribes who are most inured to the climate.

Two pahars (six hours) journey farther up, brings the canoe to the mouth of the Kalipani (black water) entering from the left. Its banks are not inhabited.

One pahar and a half (four and a half hours) take the canoe to the mouth of the Sundal, entering from the right, and having no inhabitants on its banks. At the same distance, and from the same side, enter two rivulets named Rani and Kani, the latter of which comes from the Hari jil or marsh.

One day (twelve hours) farther brings the canoe to the Jamjuni rivulet on the right. It comes from the Suksagar jil or lake, on the banks of which there are many Bengalese peasants, and a house of Radun Maniks called Udypura, or as Rennell writes, Oudapour. If he is right in placing this nineteen miles distant in a direct line from Komila, this may serve as a scale for the rate of the canoes going, as it takes thirty-four and a half hours to proceed this length; so that on a long route, a canoe does not advance more than six miles a day in a direct line. South from Udypura are Kungkis, who must be the same with the Langmang,—that I have before mentioned.

In two pahar, or six hours, farther on the left is the mouth of the Dhupa, whose banks are inhabited by Kungkis. Two gurries (forty-two minutes) from its mouth, it passes through a ridge of hills called Debta Mura—(Deities Head.)

The canoe in half a pahar (one and a half hour) more, comes to the Gangacherra, where there are no inhabitants. In two pahars more it reaches Keteycherra, also uninhabited. To the right is Kyddakacherra, where the Raja had a house named Amarapura (abode of Angels;) but in 1798 it had been deserted.

Two pahars (six hours) farther up, entering from the left, is the Moilak; one and a half pahar (four and a half hours) farther is Peelak, entering from the right; two pahars (six hours) farther, entering from the eft, is Dalak; and six gurries (two hours and twenty-four minutes) farther, entering from the right, is the Koorma. These four last mentioned rivulets have no inhabitants.

Above Koorma, in one and a half pahar, the canoe reaches Seela Gonga, on whose banks the Reang of Tripuras have a colony. This colony, there can be no doubt, is the Reang of Rennell (Bengal Atlas, map 9.) which he places on the Chingree river 105 miles from its entrance into the Karnaphuli; but I have already said, that in all probability the Chingree rises from hills on the south side of the tropic; and that what Rennell represents as its upper parts belongs to the Gomuti. Allowing that this proceeds nearly east above Oudapour, the fifty-five hours, proceeding at the same rate as between Oudapour and Romila, would bring the canoe near the Mugg mountains of Rennell, nearly at the tropic, and the Seela gonga will then be the stream represented by that eminent geographer as coming from Reang. In this case, however, the mouth of the Seela gonga would require to be placed much farther east than Rennell has done the course of his Chingree in its upper part.

The woodcutters from Komila proceed no farther up the Gomuti than the mouth of the Seela gonga, as in many parts beyond that, the channel, in February, is nearly dry, although there are deep pools between, as usual in mountainous countries; for here the river passes through what Rennel calls the Mugg mountains, beyond which nothing is known to the woodcutters, nor had they ever heard of a river called Chingree or Chimay.

The Phani (serpent) river, at the ferry between Jurilgunge and Duckinseek, to use Rennel's orthography, is of considerable size; but this is owing entirely to the tide. A little lower, indeed, at the ferry between Jurilgunge and Cossidea, it is a mile wide; but the tide flows only a little way above the ferry at Duckinseek, and the stream then is very insignificant; nor could I find that the natives ascend it in canoes, so that by far the most considerable branch of the river, as represented by Rennel, is the Muri, which comes from Kundal. This is one of many instances where a large river, on joining a much smaller one, loses its name.

ART. VIII.—*Remarks on the Culture of the Silk Worm in the North of Italy.* By JOHN MURRAY, Esq. F. A. S. F.L.S. M.W.S. Lecturer on Chemistry. Communicated by the Author.

HAVING been highly interested in the improved culture of the silk worm on the principles of Count Dandolo, and which I witnessed in full operation in the north of Italy, during the year 1818—1819, I conceived that some succinct notice of a few of the more curious facts connected with the subject would not be unacceptable to you. For the materials of this paper I am chiefly indebted to the very interesting work of Conte Dandolo "*Dell' Arte di governare i Bachi da Seta.*" *Seconda edizione, Milano*, 1818.

The hygrometer of Bellani has its *zero* correspondent with that of De Saussure, and I have connected the thermometric expression of Reaumur, used by Count Dandolo, into the scale of Fahrenheit.

Professor Giobert of Turin informed me, that the process instituted by Count Dandolo was universally successful, though some of the lower class had arrayed themselves in opposition to it, as was done in this country against the introduction of machinery to supersede manual labour,—an hostility which dicated its value.

I was informed that the Marchese de la Rovere had no less than *thirty-five ounces of ova* cultivated, (on the principles published by Count Dandolo,) in the year 1819.

The *certainty* to which the process is hereby reduced,—a certainty equivalent to the culture of an exotic in the conservatory, is not the least in the train of its recommendations. A solitary blast of the Schirroco frequently destroyed the hope and promise of the year; but all this is now avoided. The average return is more than doubled, and even successional crops may be realized. It is clearly adapted to every climate, even to a higher latitude than ours, and I cannot doubt that it is worthy the attention of our enlightened legislature; and while it might add to our finances, it would form an important and interesting feature in our industry.

According to Count Dandolo, the amount of raw silk and

arisen from misapprehension. The following are the words which I took down:

1. Sun, *sal.* 2. Moon, *tal,* or in the dialect of the Phani, *hando kree.* 3. Star, *hando goorua.* 4. Earth, *ha.* 5. Water, *tei.* 6. Fire, *hor.* 7. Stone, *holoong.* 8. Wind, *nobar.* 9. Rain, *yatei,* or in the Phani dialect, *watei.* 10. Man, *broo.* 11. Woman, *bree,* or in the Phani dialect, *brui.* 12. Head, *bokroo.* 13. Mouth, *bokook,* or in the Phani dialect, *kowk;* from which we may perhaps infer that the *bo* prefixed to this and the preceding word is the mark of some inflection. 14. Arm, *yauk,* or in the Phani dialect *yauktauk.* 15. Hand, *yaukgora.* 16. Leg, *yatee,* or in the Phani dialect *yapatoe.* 17. Foot, *yapalei.* 18. Bird, *tauksa.* 19. Fish, *aw.* 20. Good, *hamo.* 21. Bad, *hamya.* 22. Great, *godja.* 23. Little, *goorua.* 24. Long, *lawo,* or in the Phani dialect *kalow.* 25. Short, *bara.* 26. One, *kaisha.* 27. Two, *konoi.* 28. Three, *kotam.* 29. Four, *boroi.* 30. Five, *ba.* 31. Six, *douk.* 32. Seven, *cheenee.* 33. Eight, *seeko.* 34. Nine, *chee.* 35. Ten, *cheenee.* This being the same with the word given for seven, there is probably some mistake. When these people have occasion to mention higher numbers than ten, they have recourse to the Bengalese language. 36. Eat, *chaday.* 37. Drink, *loungday.* 38. Sleep, *hogulday,* or in the Phani dialect *towanay.* 39. Walk, *baraweinay,* or in the Phani dialect *ookumfeelday.* 40. Stand, *basaday.* 41. Kill, *tanday.* 42. Yes, *oonglea.* 43. No, *korey.* 44. Here, *paidee.* 45. There, *oojan.* 46. Above, *tchowo.* 47. Below, *hasseeo,* or in the Phani dialect *kamma.* From this it will appear that the Tripura language has no affinity with that of Hindustan, and very little with that of Ava. In one instance, indeed, the word *kree* (great) has evidently been introduced from the latter, the moon being called the great *hando,* and a star a little *(goorua) hando.* The word *cha* for eat is also the same with tsaw of the Ratahain dialect. *Day* or *nay* annexed to all the verbs is evidently the sign of the imperative, and is in use at Ava.

The Tripuras have features entirely like the Chinese or people of Ava, and have their huts built on posts like the latter, whose impure customs they follow, so that they must be

The comparative trials of Count Dandolo clearly prove, that the *wild* mulberry is decidedly preferable to the *engrafted* mulberry, in the value of the leaves furnished to the silkworm. The following is the Count's conclusion:

"Questi fatti adunque dimostrano che nella foglia tratta dal *gelso selvatico* comparata alla foglia *innestata* avvi sotto ad uno stesso peso copia maggiore di sostanza alimentaria, maggior copia di sostanza alimentaria, maggior copia di sostanza resinoza, e meno d'inutile sostanza parenchimosa."

Many different substances have been proposed as a substitute for the leaves of the mulberry, as those of the *lettuce, oak, elm, beet, mallow, rose, spinage, nettle,* &c. but the mulberry stands prominent, though perhaps *lettuce* might be used in the *first* period of the evolution from the ova, and until the mulberry puts forth its leaves. Only sixty lbs. weight of leaves were in 1813 consumed by the young silkworms of five ounces of ova, during the *two first* periods. The experiments of Mr. Knight show that the mulberry can be easily forced, and perhaps the same room which contains the ova would serve this purpose. In the "*British Review*" of July 1788, a writer recommends the *powder* of dried mulberry leaves; and Bertezen, (see "*Thoughts*," &c. London, 1789, p. 22,) tells us that "*one* seed of *black* mulberry leaves is worth more than two of white."

Management of the Silk Worms, produced from five Ounces of Ova.

1813. First Age.	Months.	Leaves supplied.	Internal Temperature.	External Temperature.
Days of Treatment.		lbs. oz.	Fahrenheit.	Fahrenheit.
1	May 18.	[*] 2 14	74°.75 [†]	.75
2	19.	4 0	74 .75	63 .50
3	20.	8 0	74 .75	65 .75
4	21.	4 14	74 .75	65 .75
5	22.	1 0	74 .75	61 .25
		20 0		

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[*] The common pound of silk *(libra grossa)* contains eight light ounces.

[†] Corresponding to 17° Réaumur.

arisen from misapprehension. The following are the words which I took down:

1. Sun, *sal.* 2. Moon, *tal,* or in the dialect of the Phani, *hando kree.* 3. Star, *hando goorua.* 4. Earth, *ha.* 5. Water, *tei.* 6. Fire, *hor.* 7. Stone, *holoong.* 8. Wind, *nobar.* 9. Rain, *yatei,* or in the Phani dialect, *watei.* 10. Man, *broo.* 11. Woman, *bree,* or in the Phani dialect, *brui.* 12. Head, *bokroo.* 13. Mouth, *bokook,* or in the Phani dialect, *kowk;* from which we may perhaps infer that the *bo* prefixed to this and the preceding word is the mark of some inflection. 14. Arm, *yauk,* or in the Phani dialect *yauktauk.* 15. Hand, *yaukgora.* 16. Leg, *yatee,* or in the Phani dialect *yapatoe.* 17. Foot, *yapalei.* 18. Bird, *tauksa.* 19. Fish, *aw.* 20. Good, *hamo.* 21. Bad, *hamya.* 22. Great, *godja.* 23. Little, *goorua.* 24. Long, *lawo,* or in the Phani dialect *kalow.* 25. Short, *bara.* 26. One, *kaisha.* 27. Two, *konoi.* 28. Three, *kotam.* 29. Four, *boroi.* 30. Five, *ba.* 31. Six, *douk.* 32. Seven, *cheenee.* 33. Eight, *seeko.* 34. Nine, *chee.* 35. Ten, *cheenee.* This being the same with the word given for seven, there is probably some mistake. When these people have occasion to mention higher numbers than ten, they have recourse to the Bengalese language. 36. Eat, *chaday.* 37. Drink, *loungday.* 38. Sleep, *hogulday,* or in the Phani dialect *towanay.* 39. Walk, *baraweinay,* or in the Phani dialect *ookumfeelday.* 40. Stand, *basaday.* 41. Kill, *tanday.* 42. Yes, *oonglea.* 43. No, *korey.* 44. Here, *paidee.* 45. There, *oojan.* 46. Above, *tchowo.* 47. Below, *hasseeo,* or in the Phani dialect *kamma.* From this it will appear that the Tripura language has no affinity with that of Hindustan, and very little with that of Ava. In one instance, indeed, the word *kree* (great) has evidently been introduced from the latter, the moon being called the great *hando,* and a star a little *(goorua) hando.* The word *cha* for eat is also the same with tsaw of the Ratahain dialect. *Day* or *nay* annexed to all the verbs is evidently the sign of the imperative, and is in use at Ava.

The Tripuras have features entirely like the Chinese or people of Ava, and have their huts built on posts like the latter, whose impure customs they follow, so that they must be

considered as of the same race, although their princes have adopted Hindu names and customs, and may very likely be of Hindu origin ; but I did not learn their genealogy. It is probable, however, that both they, and a considerable portion of their subjects, who in former times cultivated the plains between the eastern hills and the Megna, came from Hindustan and settled among the Tripura nation, as from their buildings they evidently appear to have been a race much farther advanced in society. The mode of succession which prevails in the family may seem to militate against the Hindu origin of the Tripura Rajas. The Raja is not succeeded by his son, but by his nephew. In 1798 the Dhup Raja was considered as the heir apparent, although his father was then alive, and an older man than Radun Manik, who then was prince. A similar practice, however, prevails in Malabar ; but then it is a sister's son who succeeds. The same indeed may be the case in Tripura ; for at the time when I noted the nature of the succession, I was not aware of the nature of the succession through females used in Malabar, and the father of the Dhup Raja may not have belonged to the family ; it may have been by his mother that he was nephew to Radun Manik.

The Tripuras cultivate what are called jooms, of which the following is the nature :—During the dry season, the people cut down to the root all the bushes growing on a sufficient extent of hilly land, that has a good soil. After drying for some time, the brushwood is set on fire, and by its means as much as possible of the large timber is destroyed ; but if the trees are large, this part of the operation is seldom very successful. The whole surface of the ground is now covered with ashes, which soak into the soil with the first rain, and serve as a manure. No sooner has the ground been softened by the first showers of the season, than the cultivator begins to plant. To his girdle he fixes a small basket, containing a promiscuous mixture of the seeds of all the different plants raised in jooms. These plants are chiefly rice, cotton, capsicum, indigo, and different kinds of cucurbitaceous fruits. In one hand the cultivator then takes a dibble, pointed with iron, if this can be procured, and with

Management of the Silk Worms, produced from five Ounces of Ova—continued.

Fifth Period	3820	0
Fourth Period	620	0
Third Period	216	0
Second Period , . . .	55	0
First Period	20	0
Leaves devoured	4731	0
	400	0
	290	0
Total . .	5421	0

For each ounce of ova, 1084 lbs. of leaves have been taken from the tree.

The silk worms, from five ounces of ova, have consumed the above 5421 lbs. of leaves, and each produced 401 lbs. of coccoons, &c.

For each pound of coccoons there have been consumed about 13½ lbs. of mulberry leaves.

The Temperature required for the Production of the Silk Worms from the Ova, anterior to 23d May, 1814.

1814. Month.	Internal Temperature.	External Temperature.	1814. Month.	Internal Temperature.	External Temperature.
May 11.	Fa. 63.50	Fa. 50.26	May 18.	Fa. 70.25	Fa. 50.00
12.	63.50	45.50	19.	72.50	50.00
13.	63.50	45.50	20.	74.75	52.25
14.	63.50	45.50	21.	77.	52.25
15.	65.75	47.75	22.	73.25	54.50
16.	65.75	52.25	23.	81.50	52.25
17.	68.	50.00			

The external temperature was ascertained at 5 o'clock every morning, from a western exposure.

During the thirteen days in which the silk-worms were developed from the ova, 134 lbs. of food were consumed. The lb. of 28 ounces is to be understood, or 2 lbs. Troy equivalent to 0.7625 kilogrammes of France.

The following is the Daily Decrease in Weight of 1000 *ounces of Coccoons in a Room, the Temperature of which is from* 70° 25 *F. to* 72° 50 *F.*

Day 1st,	1000 oz.	
2d,	991	less 9.
3d,	982	less 9.
4th,	975	less 7.
5th,	970	less 5.
6th,	966	less 4.
Day 7th,	960	less 6.
8th,	952	less 8.
9th,	943	less 9.
10th,	934	less 9.
11th,	925	less 9.

So that the 1005 ounces have lost in 10 days during the mutation 75 ounces. There is a gradual declension for the first five days inclusive, and a regular gradation for the five last days.

8 oz.	of ova have lost	in 5 days	in weight	100 gr.	in 8 days	360,	and in 10 days	440.
6 oz.	do.	do.	do.	86 gr.	do.	178	do.	248.
5 oz.	do.	do.	do.	60 gr.	do.	168	do.	216.
4 oz.	do.	do.	do.	80 gr.	do.	181	do.	224.

Each grain contains about 68 ova, and an ounce weight 39,168 ova. The *oncia Milanese* contains 575 grains. The above number is to be understood of *fecundated* ova. Those which are badly impregnated contain 43,080, and are of a *reddish* colour; and of those not at all impregnated, and of a *yellowish* tinge, there are in the ounce 44,100.

The Expense of the Contingencies of the 5 *ounces of Crop in* 1814 *are thus calculated by Count Dandolo.*

Cost of 5 ounces of ova,	15.
Wood for fuel,	1.
5500 lbs. of leaves of mulberry at 7 lire per 100 lbs.	385.
Expense of gathering the leaves,	96.5
1000 lbs. at 32 soldi,	16.
Supplement,	4.10
Supplemental paper,	4.
Oil for light,	9.
Preservation phial,	1.10
Daily labour,	100.
Lire Milanese	642.
Interest, &c. on capital,	90.
Total expense,	732.
401 lbs. of coccoons obtained, which, being sold at 78 soldi per lb. produced	1,563.18
Nett profit	Lire 831.18

Note.—A *Lira Milanese* is equal to about 8d. and there are 20 *Soldi* in a *Lira M.*

The calculation, as above, includes not only interest on capital, but a valuation on the mulberry leaves, which is about one-half of the total expence.

The Augmentation and Diminution of the Silk Worms in Weight and Size.

Increasing Progression.	Weight.	*Increasing Progression.*	Size.
100 ova weigh about	Grain 1	The ova in the 1st instance say	1 Line.
After the 1st change about	15	After the 1st change, length say	4
2d change say	94	2d change, . .	6
3d change say	400	3d change, . .	12
4th change say	1628	4th change, . .	20
5th change say	9500	5th change, . .	40

Note.—In thirty days the silk-worm has increased in weight 9500 times; and, in 28 days, the animal has augmented in size about 40 times.

The French Line is equal to 1.67 Lines English, calculating 100 Lines English to the inch.

Decreasing Progression.

	Grains.
100 Silk-Worms at their greatest size weigh above .	7760
100 chrysali weigh	3900
100 females weigh	2990
100 males weigh	1700
100 females, after the ova are deposited, weigh .	980
100 females, naturally dead, and the eggs or ova deposited, &c.	350

In the space of above 28 days more the silk-worm has diminished in weight about 30 times. Thus the length of the silk-worm from the time of its greatest increase to the moment it is converted into the chrysalis, has diminished about three-fifths.

The chrysalis is the intermediate state between the worm and the winged insect.

Space occupied by each ounce of Ova cultivated.

In the first age	an area of	square Braccia	4
In second	an area of	ditto	8
In third	an area of	ditto	19
In fourth	an area of	ditto	45
In fifth	an area of	ditto	100

Note.—The *Braccio di Milano* is divided into 12 *ounces* or inches, and corresponds to 5,95 palms, which may be calculated at 22 English inches nearly.

Amount in Weight of Mulberry Leaves consumed by the Silk Worms. For every ounce of Ova, there have been consumed 1078 *lbs. of Leaves, divided as follows, viz.*

First age eaten		lbs. 4
Second	do.	12
Third	do.	40
Fourth	do.	120
Fifth	do.	732
		lbs. 908

Leaves, &c. left destroyed unused.		
In first	age	lb. 1
In second	do.	2
In third	do.	6
In fourth	do.	18
In fifth	do.	68
		lbs. 95

In the course of the management of the silk-worms, the 1073 lbs. of leaves from the tree (from evaporation, &c.) will have lost 70 lbs.

Note.—There have been devoured by the silk-worm about 515 lbs. of pure mulberry leaves. The 1073 lbs. of leaves as taken from the tree will yield 80 lbs. of coccoons, calculating from one ounce of ova.

Art. IX.—*Account of the Specific Gravity of several Minerals.* By William Haidinger, Esq. F.R.S.E. Communicated by the Author.

The specific gravity of minerals is one of those physical properties which are most useful for the student who intends to become acquainted with the inorganic productions of nature, since it can be very easily ascertained to a considerable degree of accuracy, and is constant in minerals of the same species, or at least ranges within very narrow limits, if we have taken care to employ specimens free from visible mechanical admixtures. Too little attention has been bestowed by most mineralogists on this important branch of the resources of their science, and at a period of so assiduous labour as the present is in mineralogy, we are often referred to the determinations of Brisson or of Muschenbroek, in regard to the specific gravities of bodies, of which either the species was not correctly determined, or the great bulk employed in the experiment rendered the purity of the mass very problematic. Indications of this kind were taken upon authority, and transferred from one mineralogical work into another, but seldom verified by subsequent observations; nay, it happened sometimes, that even if there were correct statements existing, yet erroneous ones have been ignorantly selected, and the description of the species deprived of one of its most essential characters.

I have arranged in the following list a part of a series of observations which I lately had occasion to make, and which were thought by some distinguished mineralogists to contain some interesting information, as they are pure matters of fact, relating to one of the most important departments of mineralogy. The specific gravities were all taken by means of hydrostatic balances; and, what is the most necessary precaution in operations of this kind, the specimens were sufficiently purified, and the air bubbles which adhere to them when immersed in water disengaged. The numbers obtained by experiments at different temperatures, I have reduced to that of 15° centigr. or 59° Fahren. by means of tables of the specific gravity of distilled water at different temperatures, published by Dr. Young and Prof. Tralles. Most of the experiments were made with distilled water, or water obtained from melting very pure snow, and a few of them with spring water, from which the air had been disengaged. The difference in the specific gravity of these fluids is so very slight, seldom exceeding 0.001, that it will be of no consequence to leave it out of sight, as in general the range of the specific gravities within a species is much greater than could be accounted for by the difference in the specific gravity of the water employed for ascertaining it. The substances themselves are disposed nearly in the order of the system of Professor

Mohs; such species as are not yet enumerated in that system I have mentioned in those orders where they are likely to be included in future, and marked with an asterisk; such as could not be included even in this manner, are reserved for an appendix.

ORDER I. HALOIDE.

1. *Gypsum*, a perfectly white transparent crystal, from Oxford,	2.310
2. *Anhydrite*, a rectangular four-sided prism, obtained by cleavage, grey, semitransparent, from Hall, Tyrol,	2.899
3. *Alumstone*, the crystallised variety on the surface exposed in the drusy cavities, from Tolfa,	2.694
4. The compact part of the same specimens,	2.671
5. *Kryolite*, the white cleavable variety,	2.963
6. *Apatite*, massive, asparagus-green, transparent, from Salzburg,	3.180
7. *Apatite*, asparagus-green crystals, from Cabo de Gata,	3.225
8. *Fluor*, combinations of the hexahedron and octahedron, dark violet-blue, from St. Gallen, Stiria,	3.140
9. *Fluor*, an octahedron obtained by cleavage, of a greenish-blue colour, from the Hartz,	3.163
10. *Fluor*, twin-crystals, pale violet-blue by reflected light, yellowish white by transmitted light, Alston,	3.177
11. *Fluor*, an octahedron obtained by cleavage, pale violet-blue, Alston,	3.178
12. *Arragonite*, yellowish-white, perfectly transparent crystals, from Bohemia,	2.931
13. *Calcareous spar*, a brown cleavable variety,	2.715
14. *Calcareous spar*, another brown cleavable variety, but presenting curved faces of cleavage,	2.721
15. *Calcareous spar*, crystallised in the form $(P+1)^{\frac{5}{3}}.R+\infty$, white, semi-transparent, from Alston, Cumberland,	2.721
16. *Calcareous spar*, yellowish grey, small individuals, aggregated in a granular composition,	2.727
17. *Calcareous spar*, individuals of a columnar composition, honey-yellow, semi-transparent,	2.731
18. *Calcareous spar*, in large cleavable individuals, of a reddish-brown colour, owing to the admixture of oxide of iron. This variety was sent from Paris to the collection at Gratz, as *Chaux carbonatée ferrifère*,	2.778
19. *Calcareous spar*, white translucent cleavable masses, engaged in the hydrate of magnesia from Unst, (see ORDER V. 20.)	2.647
20. *Calcareous spar*, crystals of the form of the fundamental rhombohedron, associated with small crystals of adularia, epidote, and chlorite, from Dauphiné.	2.508

This is a remarkable variety. I could not find a difference in its angles or in its hardness from Iceland spar, and yet the substance seemed perfectly homogeneous.

21. *Macrotypous lime-haloide, Brown-spar,* greyish-white crystals of the form R, perfectly cleavable in pretty even faces, lustre almost pearly. Is found in Gollinggraben in Salzburg, in fissures of a limestone rock, 2.842

22. *Brown spar,* greyish-white, easily cleavable, affording brilliant planes, Freiberg, 2.861

23. *Brown spar,* reddish-white crystals of the form $R.(P)^3$, from the Himmelfarth mine near Freiberg, 2.870

24. *Rhomb spar,* greyish-white, cleavable, from a bed of octahedral iron ore, where it is associated with amphibole, &c. from Presnitz, Bohemia, 2.859

25. *Dolomite,* white granular composition, forming the mass in which tremolite is imbedded, from St. Gothard, 2.859

26. *Rhomb spar,* yellowish-white, perfectly cleavable, 2.878

27. *Ankerite,*§ yellowish-white cleavable masses from Eisenerz, Stiria, 3.000

28. *Ankerite,* in granular compositions consisting of small individuals of a grey colour, from the Raiding mountain in Stiria, 3.049

29. *Ankerite,* a greyish-white granular variety, from the valley of Rötz, in Stiria, 3.084

30. *Ankerite,* large cleavable masses, of a cream-yellow colour, from Golrath, Stiria, 3.089

31. *Breunnerite*†, a clove-brown, perfectly cleavable variety, forming imbedded crystals, from the Tyrol, 3.001

*32. *Wavellite,* globular shapes of a dirty asparagus-green colour, from Barnstaple, Devonshire, 2.337

ORDER II. BARYTE.

1. *Red manganese,* a massive variety, compound parallel to the planes of $R-\infty$, like slate spar, from Beschertglück mine near Freiberg, 3.428

2. *Sparry iron,* crystals from the Pfaffenberg mine, near Harzgerode, in the Hartz, 3.829

3. *Prismatic Zinc-baryte,* yellowish-white semi-transparent crystals, from Rossegg, Carinthia, 3.380

4. *Rhombohedral Zinc-baryte,* honey-yellow crystals, in the

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§ I venture to propose this name for the paratomous Lime-haloide of Mohs, in honour of Professor Anker of Gratz, an individual who has done much in investigating the mineralogy of his country, Stiria, where this substance occurs in immense quantities, and has been first distinguished as a particular species by Professor Mohs. It is mentioned in the *Edinburgh Journal of Science,* No. II. p. 325.

† This is the brachytypous Lime-haloide of Mohs, the carbonate of iron and manganese of Brooke. It was first discovered and distinguished from the other species of the genus Lime-haloide, by Mr. Mohs, while at Gratz, and described in his *Characteristic of the Natural History System,* published in 1820. It is named in honour of Count Breunner, an Austrian nobleman, well known in this country, who unites an extensive knowledge in several departments of natural history, with much zeal for the promotion of the sciences.

shape of rough six-sided pyramids, from Altenberg, near Aix-la-Chapelle,	4.441
5. *Tungsten*, a fragment of a yellowish-white translucent crystal, from Schlaggenwald, Bohemia,	6.076
6. *Strontianite*, delicate white crystals, aggregated to globular groupes, from Bräunsdorf, Saxony,	3.605
7. *Celestine*, fragment of a cleavable white translucent mass, engaged in trap, from the Tyrol,	3.858
8. *Witherite*, a cleavable variety; yellowish-white, and semitransparent, from Anglesark, Lancashire,	4.30
9. *Heavy spar*, very thin tabular bluish-white semitransparent crystal, of the form *primitive* of Haüy, from Kremnitz, Hungary,	4.412
10. *Heavy spar*, a number of small transparent columnar crystals, of a white colour, from the Hartz,	4.415
11. *Heavy spar*, cleavable, very pale yellowish-grey, and translucent, from Marienberg, Saxony,	4.415
12. *Heavy spar*, the variety called prismatic heavy spar by Werner, pale yellow, transparent crystals, very perfectly formed, and imbedded in a large translucent crystal of straight lamellar heavy spar,	4.426
13. *Heavy spar*, prisms obtained by cleavage, white, and semitransparent,	4.430
14. *Heavy spar*, yellowish translucent crystals, from Kremnitz,	4.430
15. *Heavy spar*, similar crystals from Beschertglück, Freiberg,	4.445
16. *Heavy spar*, white, semitransparent crystals, from Beschertglück,	4.446
17. *Heavy spar*, smalt-blue transparent tabular crystals from Offenbanya, Transylvania,	4.473
18. *Heavy spar*, a white transparent crystal from Dufton, Westmoreland,	4.480
19. *Heavy spar*, in white faintly translucent columnar compositions, commonly called columnar heavy spar, from the abandoned mine of Lorenz Gegentrum, Freiberg,	4.488
20. *Heavy spar*, a single columnar crystal, pale smoke-grey, translucent, from Hiskow near Nissburg, Bohemia, where it occurs with copper-pyrites, blende, and calcareous spar, in a kind of septaria,	4.493
21. *Heavy spar*, pale yellow transparent columnar crystals, from Przibram, Bohemia,	4.210
22. *Heavy spar*, prisms obtained by cleavage from wax-yellow, translucent, tabular crystals, from Bleiberg, Carinthia,	4.679

The two last varieties differ so much in their specific gravity from each other, and from the rest of the heavy spars, that I was led to suppose the angles of their forms would differ from each other. I had ere then measured the angles of several varieties, which did not agree with each other, and found that these differences in the angles were in close relation with the degrees of specific gravity. I have not, however, so far succeeded as to establish clearly the specific difference among these substances, which is indicated by several of their properties. Mr. Mitscherlich is at present occupied in ascertaining several of them; and also in examining the chemical composition of the substances themselves, in search of the isomorphous bodies of sulphate of strontia and sulphate of lead.

23. *Di-prismatic Lead-baryte,* (carbonate of lead,) columnar compositions, perfectly white, almost opaque, from the Hartz, 6.339

24. *Di-prismatic Lead-baryte,* similar composition, but of a yellowish colour, superficially almost brown, from the Hartz, 6.417

25. *Di-prismatic Lead-baryte,* greyish-white, easily cleavable crystals, from Bleiberg, Carinthia, 6.461

26. *Di-prismatic Lead-baryte,* fragment of a white strongly translucent crystal, from Leadhills, 6.465

27. *Rhombohedral Lead-baryte,* (phosphate of lead) a single green crystal, from Zschopau, Saxony, 7.098

28. *Arseniate of lead,* bright yellow crystals, from Johanngeorgenstadt, Saxony, 7.212

There is a considerable difference between this and the preceding variety in regard to specific gravity, but there is likewise a difference in the form. I found the inclination of the faces of the pyramid at the base = 80° 45′ in a green variety of phosphate from Freiburg, = 80° 44′, in a green variety of the same from Cornwall, = 79° 40′, in the yellow arseniate from Johanngeorgenstadt; the correspondent angle in phosphate of lime is = 80° 25′.

29. *Hemi-prismatic Lead-baryte,* (chromate of lead) several isolated crystals from Siberia, 6.004

30. *Pyramidal Lead-baryte,* (molybdate of lead) longish deep wax-yellow crystals, from Bleiberg, Carinthia, 6.698

31. *Pyramidal Lead-baryte,* fragments of an orange-yellow, perfect crystal, from Annaberg, Austria, 6.760

32. *Prismatic Lead-baryte,* (sulphate of lead) broad deeply striated crystals, of a white colour, and faint translucency, from Leadhills, 6.228

33. *Prismatic Lead-baryte,* crystals similar to the preceding, but of a brownish colour, from Leadhills, 6.255

34. *Prismatic Lead-baryte,* a white translucent tabular crystal, from Leadhills, 6.298

35. *Prismatic Lead-baryte,* fragments of a large semitransparent crystal, from Leadhills, 6.309

36. *Axotomous Lead-baryte,* (sulphato-tri-carbonate of lead,) the acute crystals commonly called rhombohedrons, of a dark yellowish-grey colour, and translucent, from Leadhills, 6.266

37. *Axotomous Lead-baryte,* the six-sided laminae, of a pale yellowish white colour, semitransparent, from Leadhills, 6.364

During the late stay of Professors Mitscherlich and Rose in Edinburgh, I have had occasion to show them those specimens from which I had derived the hemi-prismatic form of the species. They have been perfectly convinced of the accuracy of my observations, called in question by Mr. Brooke, (*Edin. Phil. Journ.* No. XXI. p. 157.) They have also observed the double system of coloured rings exhibited by the mineral in polarised light, in a plane passing through the short diagonal of the oblique prism of 59° 40′, and the numerous regular compositions, not only deducible from experiments in polarised light, but also from the lines upon the face of P— ∞, and some that occur in other directions, of which I shall give a description, among the regular compositions of hemi-prismatic substances.

38. *White antimony,* transparent crystals, about 1‴ in diameter, yellowish-white, from Bräunsdorf, Saxony, 5.566

ORDER III. KERATE.

1. *Horn-ore,* a very pure, greyish-white, translucent variety, compounded of granular individuals, from Peru, 5.552

ORDER IV. MALACHITE.

1. *Copper-green,* massive, fracture conchoidal; colour, dark verdigris green, translucent, from Siberia, 2.031

2. *Copper-green,* thin botryoidal coats upon compact brown iron-ore, pale green, faintly translucent, Bannat, 2.206

3. *Prismatic Lirocone-malachite,* (lenticular copper,) sky-blue crystals, from Cornwall, 2.926

4. *Prismatic Azure-malachite,* (blue carbonate of copper,) fragments of very pure crystals, from Chessy, 3.831

5. *Malachite,* a cleavable dark-green variety, from Chessy, 4.008

6. *Malachite,* a fibrous dark-green variety, from Siberia, 3.802

7. *Malachite,* perfectly compact, of a pale green colour, opaque, from Schwatz, Tyrol, 3.670

8. *Prismatic Habroneme-malachite,* (phosphate of copper,) dark-green crystalline coat, from Rheinbreitbach on the Rhine, 4.206

*9. The *Radiated acicular olivenite* of Jameson, oblique prismatic arseniate of Phillips, globular shapes of a dark blue colour, a little greenish, translucent, 4.192

* 10. *Scorodite,* pale green, semi-transparent crystals, from Stamm Asser am Graul, Saxony, 3.162

ORDER V. MICA.

1. *Vivianite,* (phosphate of iron,) fragments of transparent crystals, from St. Agnes, Cornwall, 2.661

2. *Cobalt-bloom,* (arseniate of cobalt,) red acicular crystals, perfectly cleavable, from Schneeberg, Saxony, 2.946

3. *Cobalt-bloom,* showing red and green colours in the same crystals, from Gotthold-stolln near Platten, Bohemia, 3.033

4. *Talc,* apple-green laminae, from the Greiner mountain in Salzburg, 2.744

5. *Chlorite,* loose scaly particles of a dark green colour, earthy chlorite of Werner, 2.706

6. *Chlorite,* massive, composed of large granular individuals, dark green, from the Rothen Kopf mountain in Salzburg, 2.713

7. *Chlorite,* of the same kind, only the individuals smaller, 2.729

8. *Chlorite,* a similar variety, consisting of still smaller individuals, 2.731

9. *Chlorite* in large laminae, and most perfectly cleavable, more translucent, from the same locality, 2.775

10. *Chlorite,* liver-brown rhombic prisms, imbedded in compact green chlorite, from the same locality, 2.781

11. *Chlorite,* composition almost impalpable, and fracture slaty, of a dark mountain-green colour, 2.799

This variety contains minute crystals of rutile.

12. *Green-earth,* a compact, celandine-green variety, from Monte Baldo, near Verona, 2.834

On account of the difficulty of obtaining it free from mechanical admixtures, this specific gravity is perhaps not quite exact.

13. *Mica,* perfectly cleavable individuals, engaged in granite, showing iridescent fissures parallel to the laminae, colour oil-green perpendicular to the axis, more brown parallel to it, from the Schwamberg Alps in Stiria, 2.883

It has two axes of double refraction, like the white mica from Siberia.

14. *Mica,* perfectly black, in a granular composition, exhibiting a tendency to slaty structure, from the district of Pinzgau in Salzburg, 2.911

15. *Mica,* silver-white crystals from Zinnwald, Saxony, 2.945

16. *Mica,* greenish-black, in large perfectly cleavable individuals, Siberia, 2.949

17. *Lepidolite,* peachblossom-red, compound of granular individuals, from Rosena, Moravia, 2.831

18. Another specimen of the same, 2.833

19. *Pearl-mica,* perfectly cleavable, reddish-white crystals, 3.022

*20. *Hydrate of magnesia,* white laminae, perfectly cleavable and translucent, from Unst, 2.350

(To be continued.)

ART. X.—*On the Meteorological Tables kept in 1822 at Macquarie Harbour and Hobart's Town in Van Diemen's Land, and transmitted to the Royal Society of Edinburgh.* By his Excellency Sir THOMAS BRISBANE, K.C.B. F.R.S.*

THE Meteorological Registers now laid before the Society were kept in the year 1822, and contain regular observations on the barometer and thermometer, and on the general state of the weather.

The state of the barometer and thermometer was marked five times a day, or every three hours, from 9 o'clock in the morning till 9 at night. Had the observations been continued during the night at 12 o'clock, and at 3 and 6 in the morning, the average of these would have given a very correct measure of the mean temperature of the day; but as the thermometer was not marked at these hours, it becomes necessary to reject entirely the observations made at noon, and at 3 and 6 o'clock in the evening, and to deduce the mean temperature from those made at 9 o'clock in the morning, and 9 o'clock in the evening.

By this process, the propriety of which cannot admit of the slightest doubt, we obtain the following mean monthly temperatures for Hobart Town and Macquarie Harbour:

1822.	Hobart Town.	Macquarie Harbour.	
January,	63°.06 Fah.	64°.23	Estimated.
February,	63.07	64.23	
March,	55.46	56.00	
April,	53.47	57.56	
May,	45.72	48.88	
June,	40.68	43.05	
July,	40.18	45.46	
August,	45.56	48.40	
September,	47.13	58.79	
October,	54.06	56.51	
November,	57.60	57.90	
December,	63.04	64.23	
Mean,	52°.42	55°.44	

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* These valuable Tables have been deposited in the Library of the Royal Society. As they are too bulky for publication, the following Report upon them was drawn up by the Secretary, and read to the Society.

Hence the mean annual temperature of Hobart Town at a point 28½ feet above the level of the sea, and situated in 42° 53′ 22″ of south latitude, and 147° 34′ 39″ of east longitude, is 52°.42; and the mean annual temperature of Macquarie Harbour, at a point 26 feet above the level of the sea, and situated in 42° 11′ 38″ of south latitude, and 145° 27′ 30″ of east longitude, is 55°.44.

As these observations, along with those made at Paramatta, are the only ones that have been made in the southern hemisphere, with the exception of those made at the Cape of Good Hope, they become of great importance, in so far as they enable us to compare the distribution of heat in the southern, with that which takes place in the northern half of the globe.

The latitude of *Hobart Town* does not differ greatly from that of *Rome*, and yet the mean temperature of *Rome* is 60°.44, while that of *Hobart Town* is only 52°.42, making a difference in favour of the European climate of nearly 7°, when an allowance is made for the difference of latitude.

On the other hand, the town of *Salem* in Massachusets, which has almost exactly the same latitude as *Hobart Town*, possesses a mean temperature of 48°.68, making a difference in favour of the Australasian climate of nearly 4°.

The climate of Hobart Town, therefore, is intermediate between that of Europe and America, and affords us reason to believe that the isothermal lines in the southern hemisphere are related, as they are in the northern one, to two poles of maximum cold, which have nearly the same position as the magnetic poles of the earth.

In order to determine this point, I have computed the mean temperature of Hobart Town, by supposing the poles of maximum cold to have the same position in the southern as they have in the northern hemisphere. If we suppose the pole nearest to Hobart Town to have the same degree of cold as the American pole, then the mean temperature of Hobart Town will be 53°.11; differing little more than half a degree from the observed mean temperature; and if we suppose it to be the same as the Asiatic Pole, the mean temperature will be 54°.67, differing 2° from observation. It deserves to be remarked, however, that *both* these computed results *lie between* the mean temperature actually observed at

Hobart Town and at Macquarie Harbour; so that either of the two formulae which represent the distribution of heat in the northern hemisphere gives for Van Diemen's Land results so correct as to be comprehended within the range of those which have been deduced from observation.

By comparing the mean temperature of Van Diemen's Land with that of the Cape of Good Hope, as ascertained by many accurate observations reduced by Mr. Colebrooke, we obtain a position for the eastern pole of maximum cold in the southern hemisphere corresponding with the position of the opposite Pole in the northern hemisphere.

In the letter from Sir Thomas Brisbane which accompanies these registers, he promises to transmit to the Royal Society of Edinburgh the registers kept in New Holland, at Paramatta, the seat of government, and also at Sydney; and he mentions the very remarkable fact, which we believe to be unexampled, that though these two places are distant only *ten miles*, yet their mean annual temperature differs near TEN degrees! Sir Thomas conceives, that the cause of this remarkable fact is local, and that he will be able to give a satisfactory physical explanation of it. D. B.

ART. XI.—*Notice of the Echinodermata of the Frith of Forth.* By Mr. JOHN FOGGO, Junior, Leith. Communicated by the Author.

OF the echinodermatous *Radiaria* which inhabit the Frith of Forth, the most frequent are the different species of Asterias and Ophiura. The Asteriae are the

A. glacialis. This species appears to be gregarious, and is very abundant on the sea-shore near the neighbourhood of Leith and Newhaven. I have found some specimens with three rays, and only the rudiments of the other two visible.

A. rubens and *A. papposa.* These two species inhabit the Black Rocks near the Martèllo Tower, where they may be found at all seasons of the year. They are very often thrown ashore by the tides.

During the storm that occurred here in the second week of October 1824, a small species was picked up by Mr. R. Pollock, which does not appear to have been observed before. Its characters are, " above, muricated, disc well defined, elevated; the rays convex, 9 in number, longer than the breadth of the disc." It is about three inches in breadth, of a lively red colour, and the rays have the appearance of being slightly palmated. If it be a new species, it might be assigned a place in the British Fauna with the trivial name *Rotata.*

Of the *Ophiurae*, the most common on our coast is the

O. echinata. It may be often found at low water-mark between Leith and Portobello, and among the roots of the larger fuci left by the tide. When thrown ashore alive they often bury themselves in the sand.

O. lacertosa occurs in great numbers at Portobello harbour among the rejectamenta of the sea. I have never seen it alive.

O. bodotriae. I have given this name to a species of which I found several specimens in August 1824, near Gosford House. In appearance it is exactly intermediate between the *O. echinata* and *lacertosa.*

It is about the same size as the former, of a light brownish red, and may be easily distinguished by its spines, which are strong, patent, and very short, their length not exceeding one half the breadth of the ray; while in *O. echinata* they are much longer, and in the *lacertosa*, very delicate, and closely adpressed so as to be scarcely visible.

Good essential characters might perhaps be drawn from the form and arrangement of the scales. On the *O. echinata* there are two triangular scales, at the insertion of each of the rays, their smallest angles directed to the centre, the rest of the disc being covered with tubercles and spines in form of a stem; and, in full grown specimens at least, a ridge of tubercles extends throughout the whole length of the ray. *O. bodotriae* has the disc covered with orbicular scales arranged nearly in concentric circles, and separated from each other, as are the elliptical scales of the rays, by minute papillae and smaller scales. In the axils of the rays in the *O. lacertosa*, there is a small scale beautifully crested; on the disc, at the insertion of the rays, there are two similar scales as in the *O. echinata*, differing in size and figure from the others, which are mostly angular, and arranged in the form of a star with ten rays.

Echinus esculentus. This animal is seldom or never thrown ashore; but it is taken in great numbers by fishermen when dredging for oysters.

When floating on the surface of the water, as I have seen them on the coast of Fife, they may be approached with ease, but they sink the moment they are touched, or disturbed by the slightest rippling of the water.

Spatangus canaliferus. Among some hundreds which I have picked up, not more than two contained the living animal. Great numbers are often thrown ashore in Aberlady Bay, about a furlong to the east of Gosford House, and more sparingly on Portobello sands.

Art. XII.—*Observations on the Temperature of the Sea and the Air, made during a Voyage from the Cape of Good Hope to St. Helena, in* 1820. By John Davy, M. D. F. R. S. Communicated by the Author.

It was our intention to have reimbarked early yesterday morning, but we were prevented by a strong SE. wind. It moderated a little however in the afternoon, and we went on board. We sailed the same evening by moonlight, the wind blowing almost a gale.

April 20.

	Air.	Water.	Hygr.	Wind and Weather.
12h N.	64°	59°	—	SE. moderate, clear. Out of sight of land, water greenish.

At daylight this morning no land was to be seen; and at noon the Captain was of opinion that we were not in soundings.

It is a curious circumstance, that the temperature of the sea near the Cape shore should be several degrees lower than the mean annual temperature of the coast.

April 21. S. Lat. 31° 38′, E. Long. 14°.

	Air.	Water.	Hygr.	Wind and Weather.
12h N.	69°	67°	6°	SE. gentle, clear, water blue.
6 P. M.	66.5	65	5	Do. do. do.
8	66.5	—	3	Do. do. do.

The night was fine, and the breeze steady.

April 22. S. Lat. 30° 6′, E. Long. 11° 42′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	67°	67°	4°	SSE. gentle, clear.
10	69	68	5	Do. do. do.
12	68.5	68.5	5	Do. moderate, do.
2 P. M.	68.5	67.5	3	Do. do. do.
6	68	68	2.5	SSW. do. do.

The night was fine, and the breeze gentle. At noon the current was setting strong to the west, and a little to the south.

April 23. S. Lat. 28° 45′, E. Long. 9° 58′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	67°	68°	1°	SSE. gentle, clear.
10	68	68	2	Do. do. do.
12	67	68	1.5	S. moderate, do.
2 P. M.	67	68	2	Do. do. do.
6	67.5	68	2.5	Do. do. do.
8	67	—	1.5	Do. do. do.

The night was fine. After sunset every thing on deck seemed to be covered with dew; but a glass wiped clean and dry, and exposed to the air for half an hour, remained perfectly dry. The sails were quite wet in the morning. Does this effect arise from the deliquescence of salt, or is it owing partly to this, and partly to the formation of dew connected with the deliquescent salt, and not occurring when the latter does not take place? Perhaps the salt may have a disposing effect in regard to dew, somewhat similar to that which lime has in respect to the formation of saltpetre.

April 24. S. Lat. 26° 55′, East Long. 7° 34′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	68°	69°	5°	SE. moderate, rather cloudy.
10	68.5	69	6	SSE. fresh, pretty clear.
12	68	68.5	6.5	Do. do. rather cloudy.
2 P. M.	67.5	68.5	5	Do. do. pretty clear.
6	67.5	68	5.5	Do. do. clear.

The night was fine. The current during the last forty-eight hours has been setting pretty strongly to the west. This morning a flying-fish was seen.

April 25. S. Lat. 24° 56′, E. Long. 5° 26′.

	Air.	Water.	Hygr.	Wind and Weather.
8^{h} A. M.	69°	69°	6°	SE. moderate, clear.
10	70.5	69	7	Do. do. do.
12	71.5	69.5	8	Do. do. do.
3 P. M.	69	69	6	Do. do. pretty clear.
6	68	67	6	SSE. do. cloudy.

The night was cloudy, and the wind gentle. The current in the last twenty-four hours has been setting to the west.

April 26. S. Lat. 23° 32′, E. Long. 4° 4′.

	Air.	Water.	Hygr.	Wind and Weather.
8^{h} A. M.	69°	69°	4°	East, gentle, overcast.
10	71.5	70	5	Do. do. cloudy.
12	72	70.5	6	Do. almost calm, do.
3 P. M.	71	70.5	6	Do. do. clear.
6	68.5	70	2.5	Do. do. do.
9	68.5	—	2.5	Do. do. do.

There appears to have been no current during the last twenty-four hours. Dr. Halley observed, that an east wind at St. Helena commonly produced a cloudy sky.

April 27. S. Lat. 23° 2′, E. Long. 3° 30′.

	Air.	Water.	Hygr.	Wind and Weather.
8^{h} A. M.	71°	70°	5°	East, almost calm, clear.
10	72	70.5	7	Do. very gentle, do.
12	73	71	8	Do. do. light clouds.
3 P. M.	73	72	7	Do. nearly calm, do.
6	70	71	6	Do. calm, do.
8	69	—	5	Do. do. do.

The night was fine, and calm till midnight, when a gentle breeze sprung up from the NW.

April 28. S. Lat. 22° 43′, E. Long. 3° 26′.

	Air.	Water.	Hygr.	Wind and Weather.
8^{h} A. M.	70°	71°	5°.5	NW. very gentle, light clouds.
10	72	71	6	NNW. do. clear.
12	72.5	72	6.5	Do. do. do.
3 P. M.	73	72	7	Do. do. do.
6	70	71	5	W. by N. gentle, cloudy.
9	70	—	4	S. by N. do. do.

The night was moderate, and the wind gentle till about midnight, when it freshened, and came round more to the south.

April 29. S. Lat. 21° 23′, E. Long. 2° 3′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	70°	70°.5	6°	SSE. fresh, pretty clear.
10	70.5	71	6.5	SE. do. do.
12	70.5	71	6.5	Do. do. do.
3 P. M.	70	71	6	Do. do. do.
6	70	71	6	Do. do. do.

The night was fine, and the wind moderate.

April 30. S. Lat. 20° 6′, E. Long. 0° 13′.

	Air.	Water.	Hygr.	Wind and Weather.
8 A. M.	70°	71°	8°	SSE. moderate, overcast.
10	70.5	72	8	Do. do. do.
12	71.5	72	8.5	Do. do. pretty clear.
3 P. M.	70.5	72.25	7.5	Do. do. do.
6	70	72	7	Do. do. clear.

The night was fair. Towards morning the wind changed, became more easterly, and produced a cloudy sky.

May 1. S. Lat. by Dr. R. 18° 44′, W. Long. 1° 22′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	70°.5	72°	10°	ESE. moderate, cloudy.
10	71.5	72.5	10	Do. do. overcast.
12	72.5	72	11	East, do. do.
3 P. M.	72	72.5	8	Do. do. clear overhead.
6	71	72	9	Do. do. clear.
10	71.5	—	10	ESE. do. do.

The night was fine.

May 2. S. Lat. by Dr. R. 17° 31′, W. Long. 2° 44′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	73°	72°.5	9°	ESE. moderate, clear.
10	73.5	73	8.5	E. by S. do. do.
12	73.5	73	8.5	E. by N. do. do.
3 P. M.	73	73.5	8.5	NE. do. cloudy.
6	72	73	9	E. do. clear.

The night was fine.

May 3. S. Lat. 16° 19′, W. Long. 4° 27′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	73°	73°.5	8°	East, moderate, cloudy
10	75	73.5	10	ENE. do. do.
12	76	74	10	Do. do. clear.
3 P. M.	73.5	74	8.5	Do. do. do.
6	72.5	74	8.5	E. by N. do. do.

The night was fine.

May 4. S. Lat. 15° 55′, Long. and James's Town 5° 36′ 30″ West.

	Air.	Water.	Hygr.	Wind and Weather.
6h A. M.	72°	73°.5	7°	ESE. moderate, cloudy.
8	72.5	73.5	8	Do. do. do.
10	74	74	9	Do. do. do.
12	76	74	10	Do. do. do.
1 P. M.		74	—	Do. do. do. 7 miles from shore.
2		74.5	—	Do. do. do. 4 miles from shore.
3	75	74.5	7	Do. do. do.
4½		74.5	—	Do. do. do. 3 miles from shore.
6	74	74.5	7	Do. do. do. ½ a mile off James's town, at anchor in 21 fathoms.

May 5. At anchor off James's Town.

	Air.	Water.	Hygr.	Wind and Weather.
7h A. M.	—	74°	—	——

As we approached nearer St. Helena, the land appeared bolder, and when we were only two or three miles distant, the features of the island were wild and grand in the extreme, consisting of perpendicular and very lofty cliffs, craggy peaks and hills, and mountains parched, brown, and barren, as if just thrown up by a volcano. The only exception to this remark appeared in the high central neck of land, where there was a stripe of verdure, and where we could distinguish the buildings of Longwood.

In consequence of the dark bottom of the road, the water, even in soundings, continues of a dark blue colour. It is remarkable that in approaching St. Helena, the temperature of the sea at its surface does not change. This is probably owing to the peculiarity of the island being situated in the unfathomable ocean, and not surrounded by shoals, as islands generally are.

Very little is known respecting the climate of St. Helena. More rain is said to fall at Plantation House, than in the wettest part of Devonshire. The mean annual temperature appears to be 64°, the thermometer rarely falling to 54°, and seldom rising to 74°. For weeks together in the house, it has been observed at 64°. The temperature of Longwood is considered a little lower than that of Plantation House, and that of James's Town about 10° higher.

This island is generally considered as of volcanic origin, and all my observations confirm this opinion. The rock of which the island consists exhibits great variety. In some places it is very like basalt in texture, colour, and general character. In other places it is extremely porous, vesicular and cellular, indeed almost cavernous. Very often it has quite the appearance of a slag. In a part of a rock remarkably cellular, stalactites had formed exactly like some I had seen in the Museum of the Royal Society of Edinburgh, and which had been brought by Sir George Mackenzie from Iceland, and were decidedly of igneous origin. The substance of those I saw at St. Helena was very like compact basalt. In some places the rock showed a slaty structure, the imperfect strata appearing variously inclined.

In point of disposition to decompose, the rock exhibits much variety. In the same mass some part is entirely decomposed and converted into clay, another part is undergoing the change, and in different states of its progress, while another part is not in the least altered. The decay of course is greatest at the surface, where the rock is exposed to the atmosphere, but it is not confined to the exposed parts.. The clays which are formed from the decayed rock are of several colours, of which brick red and pink red are the most common. The latter I suspect is produced by manganese. I did not see or hear of any beds of ashes or of pumice in the island.

Owing to the facility with which most of the rocks decompose, the soil is in general deep. Even in the most barren spots in the neighbourhood of James's town, there did not appear to be any deficiency of soil, and I have no doubt that if the lower grounds were as well watered as the higher ones, they would be little inferior to them in fertility.

At St. Helena the quantity of rain that falls seems to be proportioned to the height, but in what ratio I could not ascertain. At James's town very much less falls than at Plantation house, and much seldomer at the former than at the latter. Lime occurs in two places in the island. It was described to be imbedded in the Lava Rock, and is an agglutinated mass. I could not see a specimen of it; but from what I could learn, it is a saturated carbonate.

Although it is said that no minerals occur in the island, yet I found several specimens of lamelliform stilbite, and two or three specimens of mesotype imbedded in lava, resembling basalt. Near the landing place, and in my ride to Longwood, I think I detected olivine and augite in a very compact lava. I am not quite certain of this, as the crystals were very small, and my examination of them hurried.

We returned from our ride to James's town about two o'clock; and almost immediately after sunset weighed anchor, and continued our course.

Diana's Peak, the highest point of the island, is stated to be 2692 feet above the level of the sea. The following heights I determined by the barometer:

	Height above the Sea.
Cuckold's Point	2672 feet.
Halley's Mount	2467
Flag Staff	2272
Burn	2015
Longwood	1762

Art. XIII.—*Account of an Insect of the Genus Urocerus, which came out of the Wood of a Table.* By Mr. John Foggo, Leith. Communicated by the Author.

The insect I am about to describe is a species of *Urocerus*, and is quite distinct from the *U. gigas*, the only British species which has any resemblance to it. It protruded from a folding table of fir veneered with mahogany. When the insect was discovered, the table had been folded for some days; and what first excited observation, was a large quantity of very fine dust which covered the whole of the under leaf. On examination, it was found to have proceeded from a hole in the upper leaf, and to have been occasioned by the insect, in attempting to escape from its confinement. It had penetrated the under leaf to the depth of $\frac{1}{8}$ of an inch. Fortunately, the table was in the possession of Mr. Robert Strong, junior, a gentleman who could well appreciate the value of the incident. Mr. Strong carefully removed the insect from its cell, and found it dead, no doubt suffocated, the circulation of air in the room recoiling upon it the dust which its own exertions had made. Having taken proper precautions, he has so far succeeded, as now to have it in a tolerable state of preservation, with the exception of the antennae and palpi, which gave way in the process. See Plate II. Fig. 4. It is in length rather more than an inch, exclusive of the horn-like process which gives the generic name, and is two lines long. When the animal was discovered, the antennae were reflected, lying close to the back, and reached to the anterior of the last segment of the abdomen. One of the palpi is still attached to the head; it is of a yellow colour, increasing in thickness towards the tip. The head is rather compressed than globular, with a large yellow protuberance behind each eye. The throat, trunk, and part of the head are covered with short stiff brown hairs. The scutellum is ovato-acuminated, of a dark brown colour; the thighs and anterior segments of the abdomen are also of a brown colour, the rest yellow. The vagina extends about three lines beyond the extremity of the horn.

Within these few years, several instances exactly similar to the above have been published, but as yet no satisfactory explanation has been given. By some naturalists, they have been considered quite analogous to the well-known facts of reptiles being found alive in solid rocks, and have been referred to the same cause, a temporary suspension of the vital functions. The circumstances, however, are essentially different. We have reason to believe, that the reptiles were enclosed in the same state as when they were discovered. But with respect to the insects, in whatever state they entered the tree, they must have undergone some of the different processes of transformation. It becomes, therefore, interesting to ascertain in what state the animal has existed during its confinement, and what are the causes which have retarded its advancement to maturity. A late author has conjectured, that the ovum from which the insect was produced, having been prevented from undergoing the necessary evolution, had retained its animating principles till summoned into action by some change in its relation to external objects; and further, that it might have lain dormant for an indefinite space of time. The same author has likewise endeavoured to explain in this manner the periodical visitation of the locust, palmer worm, Hessian fly, *&c.* with the additional hypothesis that certain modifications of the atmosphere may be peculiarly favourable for their production. This explanation, however, is liable to several objections. It is difficult to conceive any cause that could operate year after year in preventing the animal from arriving at maturity, and that too, apparently in the very situation selected by the instinct of the mother. Moreover, on examining the cavity in which this animal was lodged, it is evident that, while within the tree, it must have passed its life in an inert state. This is a fact which is scarcely consistent with our knowledge of the economy of insects, for they are, I believe, always most voracious in the larva state. It is, therefore, most probable, that the larva penetrated the tree in order to prepare for becoming a chrysalis, and having at last assumed its perfect form, emerged into light in the usual time. That the insect made its appearance in the ordinary period peculiar to the species, is rendered probable from several collateral facts. It is well known that several species of insects remain in the chrysalis for many years; that the locust appears in numbers, once only in 17 years, and the palmer worm in 30 years, yet these are cycles not recognised by meteorologists. The tribe Urocerata is also subject to periodical swarming, "et paraissent certaines années en telle abondance quils ont été pour le peuple un sujet d'effroi." Mr. Marsham mentions, that several individuals of the Urocerus Gigas issued from the planks forming the floor of a bed-room. A solitary individual of the *U. psyllius* was taken in the neighbourhood of Edinburgh, which very likely found its way into this country by a similar means.

Art. XIV.—*On the Regular Composition of Crystallized Bodies.* By William Haidinger, Esq. F. R. S. E. Communicated by the Author.—(*Continued from Vol. I. p.* 333.)

Among those minerals of the rhombohedral system, which present regular composition in directions inclined to the axis, Calcareous spar is one, whose individuals assume a great number of different positions, and produce a variety of curious and interesting phenomena; not only from the position of the individuals, but also from the mode in which their substance is extended in regard to the faces of composition.

One of the rarer occurrences is represented Plate III. Fig. 1. The form of the individuals is that of the rhombohedron, $R - 1$, called *équiaxe* by Haüy. The axis of revolution is parallel, the plane of composition perpendicular to one of the edges of this rhombohedron. Its crystallographic sign will be $R - 1$, $\left\{\frac{R-2,\, R-1}{3}\right\}$. The rhombohedron in this variety is occasionally combined with the faces of $R + \infty$; I found it in the Ludewig vein in the mine of Beschertglück, near Freiberg.

More frequently the regular composition is parallel to one of the faces of R, the rhombohedron of 105° 5′, which is the fundamental form of the species. One of the most simple varieties is that of Fig. 2, a group from the Hartz, in the collection of the Mining Academy at Freiberg. Its sign is $R - \infty.\ R + \infty$, $\left\{\frac{R}{3}\right\}$. Thus, likewise, Fig. 3. is composed; the form of the simple individuals, however, is $R - 1.\ R + \infty$. This variety is from the Himmelsfürst mine, near Freiberg. If the prism is long in comparison with the diameter of the crystals, the compound group takes a geniculated appearance, not uncommon among the claviform crystals from Bräunsdorf near Freiberg, of which Fig. 4. is a representation. I have seen a specimen from the same locality, in the possession of Mr. Breithaupt, in which the substance of the two individuals was continued beyond the face of composition, and produced the cruciform appearance of Fig. 5, designated by $R - 1.\ R + 1.\ R + \infty,\ 2\ \left\{\frac{R}{3}\right\}$. The composition of some of those called heart-shaped twins, first described by Count Bournon, may be explained according to the same law. Mr. Allan possesses a beautiful crystal of this kind, which is represented in Fig. 6. Its crystallographic sign is $R - 1.\ (P)^3.\ R + \infty,\ \left\{\frac{R}{3}\right\}$. Another equally interesting crystal is the one of Fig. 7, likewise in Mr. Allan's collection, and denoted by $(P)^5.\ R + \infty,\ \left\{\frac{R}{3}\right\}$. In a regular composition of the simple pyramid according to this law, Fig. 8, the edges x and x will include an angle of 144° 32′. It is an acute terminal edge of each crystal, which terminates here in the re-entering angle. The crystals of this and the preceding variety are generally a little flattened, as represented in the figures. The angle included by the edges w and w is $= 141° 44'$.

The most common, however, of all the regular compositions in Calcareous spar, is that parallel to one, or even parallel to all the faces of $R - 1$. Of the first of these cases, Figs. 9. 10. and 11. represent interesting varieties. Fig. 9. is expressed by the sign $R - \infty.\ R - 1.\ R + 1.\ R + \infty,\ \left\{\frac{R-1}{3}\right\}$. It refers to a variety from the Hartz, in the possession of Mr. Sack of Bonn. Fig. 10. is from the mine of Himmelsfürst near Freiberg. I have been indebted for a specimen of it to Mr. Euler of Deuxponts. Its crystallographic sign is $R - 1.\ R + \infty,\ \left\{\frac{R-1}{3}\right\}$. The variety, Fig. 11, expressed by $(P)^{11},\ \left\{\frac{R-1}{3}\right\}$, has been discovered by Mr. Allan in a vein eighteen inches wide, and consisting only of this species, near Westmanhaven in Stromoe, one of the Faroe islands, and first described by Count Bournon. The crystals are perfectly transparent, and generally lengthened in the direction of $a\,b$, as the figure indicates. The variety Fig. 12, from Chamouni, in the collection of Mr. Allan, is expressed by $R - \infty.\ R,\ 2\ \left\{\frac{R-1}{3}\right\}$. The two individuals do not terminate at the face of composition, but they reach beyond it, which produces the cruciform aspect of the whole, and the parallelism of the face P in one, with P' in the other individual. The incidence of o on o' is $= 127° 29'$. The face of composition in Fig. 13. is perpendicular to one of the terminal edges of R. This is the supplemental composition of that according to which Figs. 9. 10. and 11. are grouped. The variety Fig. 12.

contains them both, and thus demonstrates that the two apparently different laws of composition enter in fact within a single one. The sign of Fig. 13. is $R-1 . R . R+1 . (P)^5 . R+\infty , \left\{\frac{R-1 . R}{3}\right\}$. It has been found at Bleiberg, in Carinthia. The angle at which the acute terminal edges x and x' of the two individuals meet, is $= 106° 16'$. Fig. 14. represents the simple pyramid $(P)^5$, composed according to this law, perpendicular to an edge of R, and forms an interesting point of comparison with Fig. 15, which contains two individuals possessing the same simple form, but joined according to the above-mentioned supplemental law, parallel to one of the faces of $R-1$. The inclination of the two obtuse edges y and y is $= 171° 18'$. Both these kinds of composition are united in Fig. 16, which will serve to illustrate the mode of their formation. A variety similar to Fig. 15. is preserved in the Wernerian collection at Freiberg.

In Fig. 17, which represents a group of crystals of the form $R-1 . R+1$, $\{R-1 . R\}$, the composition takes place perpendicularly to all the terminal edges of R at once, so that the group seems to consist of a central crystal, round which the others are aggregated. Generally, however, in this case each of the crystals joined to the central one, again has crystals attached to it, according to the same law. This variety has been found at Moldawa, in the Bannat, where it occurs with malachite and brown iron ore.

If R, the fundamental rhombohedron of the species itself, be composed parallel to one of the faces of $R-1$, the result will be like Fig. 18, a form which it is very common to obtain among the cleavages of this species. Among many examples, some of the most distinct are found in the varieties from the Pfaffenberg mine, near Harzgerode. Generally, however, the reversed situation of one of the parts of the rhombohedron in respect to the other, is soon interrupted by another part of the first joining in a plane parallel to the former composition, which again makes room for part of the second, and so on, and thus produces a succession of laminæ belonging to two individuals, Fig. 19. If these plates are thin enough, they produce striæ upon two opposite faces of a rhombohedron parallel to the horizontal diagonals, which will be observable upon all the faces of cleavage, if the composition take place parallel to all the faces of $R-1$. Very often the substance of the two or more individuals may be separated with considerable facility in the faces of composition, and produces what has hitherto very often been erroneously considered as cleavage. Thin plates of one individual engaged in another, according to this law, occur from the most beautifully transparent Iceland varieties, down to the quite opaque ones; they also occur in other species, whose forms resemble those of Calcareous spar, as in the Paratomous Lime-haloide, mentioned above, but particularly in Sparry Iron-ore. I have succeeded in extracting from a variety of the latter, found at Niederalpel in Stiria, the form represented in Fig. 20, bounded partly by faces of cleavage *P*, *P*, *P*, partly by faces of composition *g*, *g*, *g*, the whole being, in no small degree, alike to certain varieties of Sphene. Also, in respect to cleavage, the composition perpendicular to the terminal edges of R sometimes takes place at the same time in three directions, as in the case of Fig. 17. Thus, is the variety Fig. 21. composed of four individuals, three of which are joined to a central one, according to the above-mentioned law. Many specimens of this kind, containing even a greater number of individuals, joined to the outer ones of the composition, occur in a limestone quarry near Harzgerode.

The preceding law of regular composition is so frequently found in Red Silver-ore, that it may be considered as one of the greatest rarities to observe a group of crystals of this substance, which does not present it. The simplest modes of this composition are represented in Fig. 22. where it takes place only on one of the terminal edges of $R-1$, and Fig. 23. where it is met with on all the three edges at once. The sign of Fig. 22. is $R-1 . P+\infty, \left\{\frac{R-2 .\, R-1}{3}\right\}$; the sign of Fig. 23. $R-1 . P+\infty, \{R-2 .\, R-1\}$. But generally each of the three individuals, joined to the central one, in the edges *a*, *a*, *a*, has two other individuals attached to the remaining edges *b*, *b*, and *b*, so that the group becomes composed of ten individuals, or even of more if to these again other individuals are fixed. Large crystals are often surrounded in this manner by smaller ones, branching out, as it were, from the main shaft, on the alternating edges of the six-sided prism. There are hollow six-sided prisms of Red Silver-ore, from the mine of Kurprinz, in the possession of Dr. Rohatsch of Freiberg, the outside and inside of which are formed by smooth faces of crystallization. This shape depends entirely upon regular composition, the sides of the hexangular tube being formed by a tissue of small crystals, all aggregated, according to the above-mentioned law. Also the complement to this law occurs, though less frequently, if as in Fig. 24. the face of composition is parallel to one of the faces of $R - 2$.

While at Freiberg I also observed a composition similar to the preceding one in Rhombohedral Lead-baryte (the arseniate of lead) from Johanngeorgenstadt in Saxony, upon a specimen in the possession of Count Lubiensky. Two individuals of the form $R - \infty . P . P + \infty$, Fig. 25. are compound in a plane perpendicular to one of the terminal edges of the isosceles pyramid, as represented in Fig. 26.

Besides the twin-crystals described in the last number of this Journal, in Rhombohedral Iron-ore, Figs. 20. and 22. as being produced by the union of two individuals with parallel axes, there exists still another law of regular composition in that series, according to which the axis of revolution is perpendicular, the face of composition parallel to a face of the fundamental rhombohedron $R = 85° 58'$. A group thus formed of a small crystal joined to a large one, is represented in Fig. 27, and refers to a bright specimen of the specular iron-ore, from Stromboli, in Mr. Allan's collection. The faces P and P' fall into one and the same plane, o and o' produce an angle of 115° 17′. The crystals from Elba very often present traces of this composition. The lines upon their surface in a direction agreeing with that which a plane parallel to a face of R would produce if intersecting the crystal, originate in thin films of the substance being engaged in them in a reversed position, like the portion *a b c d*, in the rhombohedron, Fig. 28. The angle $P' P''$ is $= 171° 56'$. $P P' = 188° 4'$. We find this not only in crystals, but also in massive varieties; and those from Sweden, in particular, which appear to be cleavable with greater facility than others, owe the even planes, which may be obtained in the direction of the faces of R, not so much to cleavage as to their being composed in that direction. The same applies to the green varieties of Rhombohedral Corundum, or in fact to all those which seem to possess a more distinct cleavage than other varieties of the same species. The fracture of the films engaged in the mass is generally conchoidal or uneven, and only occasionally a small part of an even face will betray the reverse situation of these plates, which, if any, must take place if the cleavage itself be at least very indistinct in that direction; and the composition cannot therefore assume that remarkable appearance of the very obtuse re-entering angles, observable in cleavage, which distinguishes albite from felspar. Upon the face of $R - \infty$, this composition produces striae crossing each other at angles of 60° and 120°. Sometimes we observe these striae only in one or in two directions; and in the same manner also sometimes only one, sometimes two of the faces of R are obtained with greater facility, by breaking a mass of Corundum, than the rest, which present a glassy conchoidal fracture. It is worth noticing, that the isomorphism of the two oxides of alumina and of iron extends even to this occurrence of regular composition, which at first sight would appear to be entirely accidental. The last mode of composition also occurs in Chabasie, two rhombohedrons being joined in one of their faces. It has been observed in the varieties from Fassa, and in those from Faroe, which accompany Mesole and Apophyllite.

(To be continued.)

Art. XV.—*On the Emigration of a Colony of Caterpillars*,* *observed in Provence.* From the MS. Tour of James Skene, Esq. of Rubieslaw.

In scrambling over one of the arid coteaux above Tolonai, the beautiful summer residence of our worthy old friend, Marshal Comté Gallifet, I was attracted by the manœuvres of a troop of emigrating insects, which amused me very much. It is very easy to attribute the singular economy in the actions of the insect world to the mere influence of instinct, as the governing principle of every living thing below the scale of reason; but we must either extend the meaning of that word beyond the mere actions of an involuntary impulse, or find it fall short of explaining much of what may be observed in the operations even of that lowest tribe of creatures. We readily lavish our admiration on the wonderful arrangements of some tribes, whose operations may be more particularly exposed to our scrutiny, but this may arise fully more from our deficiency of observation or opportunity, than from the inferiority of one class to another in the marvellous nature of their operations. Wherever our observation penetrates in the wide field of nature, we shall not want cause for wonder or motives for diffidence in the limited extent of our own faculties. It is admitted that instinct may account for their proceedings so long as they remain uninterrupted by opposition, but what must we call that species of intelligence that instantly proceeds to remedy, if practicable, any unforeseen accident that may interrupt their proceedings?

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* This is probably the Phalæna processionea of Linnæus.

I observed, what appeared to me, a very slender snake, writhing across my path, which, but for the unusual season for these reptiles to appear, I should, no doubt, have passed unheeded. See Plate II. Fig. 5. Upon examination, however, it turned out to be the orderly emigration of a colony of large caterpillars. They were proceeding assiduously along the rocky path, in a line of march by single files, and so close that they appeared to have a hold each of his neighbour's tail, and the continued wave formed by their motion had a very singular effect. The stony surface of the path rendered their progress exceedingly tortuous, and interrupted by much climbing over stones, as they seemed in general more disposed to go over the top of a stone than round its base. When such obstacles occurred, the march, notwithstanding, did not sustain the slightest derangement, as no troops could mark time with greater precision and patience than the rear of the line, while the front was engaged in climbing over any obstacle, or the leader had stopped to examine the difficulty; the front, in their turn, tarrying until the rear had succeeded in surmounting the obstruction which the front had just passed. They were twenty-two in number, and nearly of the same size, except one, considerably larger than the rest, whose place was exactly in the centre of the line. The leader, on the contrary, was rather smaller than any of the rest. A large precipitous stone was in their way; the leader reared up, moving his head from side to side, as if gazing at it, or willing to reach some corner; and leading his troop round, he frequently performed the same examination, until they reached a small bush, round the stem of which he ascended, the long line following with perfect confidence, and by means of a branch of the bush, they attained footing on the stone.

Traversing the stone, the opposite side of which was quite precipitous and pretty high, it became uncommonly interesting to see how this intelligent general would proceed. He examined with accuracy, trying every possible break, during which time the main body remained patiently waiting, and without making the slightest attempt to assist in the examination, which their leader conducted with much activity and solicitude. At length, having ascertained the pass to be quite impracticable, he resolved upon a counter march, which was instantly performed with the most surprising regularity. For the whole line in succession advanced to the wheeling point on the brink before they turned, performing the evolution with as perfect precision as the best trained troops, the advancing and retreating lines passing close alongside of each other, and even climbing the same twig, while the front line descended without confusion, passing even over each other's bodies without interruption or hesitation.

Having completed their descent in the same manner as they had mounted, a new line of direction was taken, which however was very soon most alarmingly interrupted by the arrival of a woman leading an ass loaded with brush-wood, of which some branches trailed along the path. After the passage of this formidable assailant, I returned with some anxiety to examine the state of my colony, and found that they had suffered materially from the disaster, and were thrown into the greatest confusion. The line of march had been broken; a considerable body still followed the leader with a quickened pace; others, united in parties of three and four, regularly keeping their position in the rear of each other, while their temporary conductor sought, with evident anxiety, to find out the main body, hastening first to the one side and then to the other. A good many were scattered singly, and much distressed, seemingly uncertain how to proceed. I took each of them up in their turn, and with a view to ascertain the range of their vision, placed them at different distances from the main body, with their heads turned towards it, and I found that they uniformly remained quite unconscious of its presence, until placed within half an inch of each other. They then approached with evident eagerness, and were readily admitted into the line, by the rear halting until they had taken their places.

I put one of these stragglers in front, with his tail to the leader's head, but he pertinaciously refused the honour of conducting the line; a considerable sensation seemed to be communicated through the whole body at this attempt at usurpation, of which they seemed to become aware, but by what means I could not discern. As soon as this forced usurper was at liberty, he turned round to the leader, who repulsed him with vigour, and bit at him; upon which he retreated hurriedly along the line, constantly trying to get into his place, but was bit at by every one as he run the gauntlet, till at last a good natured friend permitted him to join the line. I then took out the large one, who was obviously a stupid fellow, when the rear immediately closed up the breach. I placed him at the head, and used every inducement to make him take the lead, but in vain. He seemed much confused by the hearty buffets given to him by the active little Bonaparte whom I wished him to supplant, so that he probably would have failed in regaining his place, had I not given him some assistance out of sympathy, for the distress my experiment had occasioned him. He seemed delighted to get into his place again; but was so much confused by the adventure, that he mistook the first sharp turn the line came to, and threw the whole rear into confusion. They broke their line, and much consternation and bustle ensued, until each had replaced his head close to his neighbour's tail.

I now took up the leader, obviously less, though more active and intelligent than the rest, when the alarm instantly spread over the whole line. I expected the second to take the command, but he seemed the most distressed of any, and eagerly sought about from side to side, and in his perplexity he turned quite around, as if consulting with his follower. The hesitation and confusion was now universal. Various parties broke off as the impression reached the rear, and sought anxiously about, returning again to the line. Having replaced the leader at the head, he instantly took the command, advancing with confidence, and conducting the whole line in perfect order. When I now interrupted their march, the main body no longer exhibited their former anxiety and impatience when the leader was removed, but seemed to wait with perfect composure and confidence, until the obstruction was overcome, which the leader used every means and ingenuity to accomplish. It did not occur to me till I had left these amusing travellers, to try the experiment of placing the leader in the rear, in order to observe how he would bear the degradation, and to ascertain if the head of the column would have been thereby changed.

ART. XVI.—*Notice respecting the Discovery of a Black Lead Mine in Inverness-shire, on the property of Glengary.*

THE only mines of Black Lead which have hitherto been wrought in Scotland, are those of Cumnock in Ayrshire, and of Glenstrathfarrar, in the county of Inverness.* This last mine was discovered so recently as 1816, but does not seem to have been wrought to any extent.

Under such circumstances, therefore, it is with great satisfaction that we announce to our readers the discovery of another black lead mine in Inverness-shire, on the property of Glengary. The mine is situated near the top of a rocky ravine, close to the head of Loch Lochy, on the south-east side, and within a mile of the Caledonian Canal. The mine is so situated, that an artificial trough or slide, of simple construction, like that one used at Alpnach in Switzerland, for timber, might be erected to convey the black lead ore by its own force of descent from the mine to the Caledonian Canal.

We have now before us specimens of this ore, and of the rock in which it is found, taken from the surface of the rock, where it is exposed to the action of the weather. The breadth of the vein is in many places, where it crops out, fully three feet in breadth.

Not more than a ton or two of ore has been yet taken from the mine, and that too merely gathered from the surface.

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* Black Lead has been found in Glen-Ely and Shetland.

In Plate II. Fig. 12. we have given a sketch of the appearance of the vein of black lead, from the pencil of Mr. Skene of Rubislaw, who has examined the mine, and to whom we have been indebted for the preceding particulars.

The letters B, B, B show the vein of black lead ore, and C, C, C, the clay slate rock in which it occurs.

ART. XVII.—*On the Formation of Single Microscopes from the Lenses of Fishes, &c.* By DAVID BREWSTER, LL.D. F.R.S. and Sec. R.S. Edinburgh.

HAVING been occupied for many years in a minute examination of the optical and anatomical structure of the lenses of various animals, the idea has frequently occurred to me of employing the lenses of the smaller ones as single microscopes. In putting this idea to the test of experiment, however, I did not at first obtain the results which I expected; but this failure arose principally from want of attention to several minute circumstances, which are essential to the success of the experiment.

In the examination of objects of natural history and anatomy, cases frequently occur where the compound microscope fails, and where a single lens can alone be advantageously employed. Those who have been reduced to such a difficulty, must have experienced the imperfections even of the simple instrument, and must have abandoned inquiries which promised to lead to new and important results. If the observer has lenses ground by the first artists, and has even taken the precaution of illuminating his objects with homogeneous light, so as to remove the indistinctness arising from the different refrangibility of light, he has still to encounter the equally formidable evil of spherical aberration, which in small lenses at least, we fear we shall never be able to remedy. Having been often reduced to this dilemma, it appeared to me not an unreasonable expectation, that when the joint efforts of science and practical skill had failed, we might have recourse to that pre-eminent wisdom, which He who made the eye has displayed in the structure of the crystalline lens; and avail ourselves of those single microscopes which occur in such abundance and variety in the eyes of the different classes of the animal kingdom.

As a high magnifying power is, under such circumstances, indispensable, we are of course limited to the use of the smaller lenses of animals, and perhaps also to those which have nearly a spherical form. The lenses of fishes are, therefore, most likely to answer the object which we have in view, both from their being generally of a spherical form, and from their superior density, which renders them less liable to injury than those of birds and quadrupeds, when they are in a state of preparation for use.

As the lenses of fishes, however small, are not truly spherical, but are generally of a spheroidal form, it becomes absolutely necessary, previous to their use, that we determine the optical axis of the lens, or the axis of vision of the eye from which it is taken, and place the lens in such a manner that its axis is parallel to the axis of our own eye. In no other direction but this is the albumen or matter, which composes the lens, symmetrically disposed round a given line;—and in no other direction does the gradation of density, by which the spherical aberration is corrected, preserve a symmetrical relation to the axis of vision.

When the lens, therefore, which we shall suppose that of a small Par, freshly taken from the river, has been removed, along with the vitreous humor from the eye, by cutting with a pair of sharp scissars an opening in the sclerotic coat, it should be placed upon a piece of fine silver paper, previously freed from all the little adhering fibres. The absorbent nature of the paper will assist in removing all the vitreous humor from the lens; and when this is carefully done, there will still remain round or near the equator of the lens a black ridge, consisting of the processes by which it was suspended in the eye. This black circle points out the true axis of the lens, which is perpendicular to it.

When the small crystalline has been freed from all the adhering vitreous humor, the capsule in which it is kept will have a surface as fine and smooth as if it were a pellicle of fluid. It is then to be rolled upon a piece of silver paper, by pushing it about with another piece of silver paper, and afterwards dropped from this paper into a cavity *c d*, (Plate II. Fig. 13.)

consisting of a brass rim raised upon the circular plate of brass AB, and its position shifted till the black processes, seen at N, are parallel to the circular aperture on the lower side of AB. When this is done, the axis LM will be perpendicular to the plate AB, and parallel to the axis of vision.

Having fitted up two or three lenses from the eye of a Par in this manner, I was surprised with the perfection of the magnified image thus obtained, and also with the effect which was produced, when this lens was made the object glass of a compound microscope. A lens of this description will last some hours, and may be preserved for a longer time, either by immersing it in the vitreous humor from which it was taken, or keeping it in a moist vessel. This, however, is perhaps unnecessary, as it is so easy to replace it with a new crystalline lens. It is not often that a naturalist requires more than one or two hours observation with a microscope, and if he obtains one which answers his purpose much better than any other, he need not regret the necessity of renewing it.

Art. XVIII.—*Description of a New Self-acting Lever Sluice, and of a Waster Sluice.* Invented by Robert Thom, Esq. Rothesay. Communicated by the Author.

The Lever Sluice, Plate II. *Figure* 1.

This apparatus, when placed on a reservoir that supplies any canal, mill, or other work with water, (where the aqueduct between the reservoir and such work is on a level,) will always open of its own accord, and let down the quantity of water wanted by such work and no more; so that it not only supersedes a waterman, but also saves a great deal of water.

In Plate II. Fig. 6, AB, is a tunnel through which the water passes from the reservoir to

BC, the aqueduct that carries the water to the mills.

BD, a float that rises and falls with the water in the aqueduct.

A, an aperture in the mouth of the tunnel.

E, the self-acting sluice that opens and shuts that aperture.

FG, a lever which turns upon the fulcrum H, and is connected at one end with sluice E, and at the other with the float BD.

The sluice E is here represented open, (as when the mills are going,) but when the water is stopped at the mills, it rises in the aqueduct, and with it the float BD, which raises the end G and lowers the end F of the lever FG, and shuts the sluice E. When the water is again let upon the wheel at the mills, the surface of the aqueduct falls, and with it the float, which opens the sluice E as before.

Upon the lever FG, there is another small lever KL, which turns upon the fulcrum L, and has a weight M suspended to the other end K. In the ordinary working of the apparatus this lever is quite stationary, and produces no effect whatever; but during floods the aqueduct is swelled by streams that run into it between the reservoir and the mills, and when this happens when the mills are not at work, the water, rising in the aqueduct, presses up the float upon one end of the lever when the other can get no farther down, and would thereby strain or break the apparatus; but by this contrivance this extra pressure merely pushes up the small lever KL without straining any other part. Of course, the weight M is so adjusted, that the lever KL will not at any time move till the sluice is shut, but upon the least extra pressure after it shuts, the lever will rise.

The dimensions of the float are nineteen feet square by seven inches deep; the lever is twenty-seven feet long, being twice the length between the fulcrum and the sluice, that it is between the fulcrum and the float. The sluice is three feet three inches long, and fifteen inches deep.

To determine the proper dimensions of the float, and relative lengths of the ends of the lever, it was necessary to ascertain how far the sluice required to be raised to pass the quantity of water wanted, and also how far the water in the aqueduct might be raised above the level absolutely necessary for supplying the works; the first was found to be seven inches, and the last only four inches. The end of the lever connected with the float was made therefore only half the length of the end connected with the sluice; and the float was made of such dimensions, that when sunk half an inch in water, the weight of water thereby displaced was equal to twice the weight required to shut the sluice.* When, therefore, the water in the aqueduct rises upon the float half an inch, (besides what it sinks by its own weight,) the sluice begins to move; and by the time the water rises other three inches and a half, the sluice is of course seven inches down, or shut.

This apparatus was erected at Rothesay in 1816.

The Waster Sluice, PLATE II. *Figure* 7.

This sluice, when placed upon any river, canal, reservoir, or collection of water, prevents the water within the embankment from rising above the height we choose to assign to it; for whenever it rises to that height the sluice opens and passes the extra water; and whenever that extra water is passed, it shuts again; so that whilst it saves the banks at all times from damage by overflow, it never wastes any water we wish to retain.

ACBL is part of a canal, river, stream, or collection of water.

BC, high-water-mark, or the greatest height to which the water is to be allowed to rise.

BD, a sluice, or folding dam, which turns on pivots at D.

EF, a hollow cylinder, having a small aperture in its bottom, to which is joined,

EL, a small pipe always open.

IIII, small holes in the cylinder EF, on the line of high-water-mark.

GH, another cylinder, water proof, that moves up and down freely within the cylinder EF; and the weight of which keeps the sluice BD shut by its connection with

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* Twice the weight, because here the lever is two to one against the float. To ascertain the power required to open or shut the sluice, (which is easily done by a lever and weights,) it must be tried when the water in the reservoir is at the highest, which, in this case, is seven feet above the bottom of the sluice. To ascertain how far the sluice must be raised to pass the necessary supply, it must be tried when the water in the reservoir is nearly at the lowest, and in this instance was done when it stood three feet above the bottom of the sluice. The quantity of water required is equal to about the power of fifty horses, the fall at the wheel being twenty feet. The aqueduct is about seven hundred yards long, twelve feet wide, three deep, and its bottom about twelve inches lower than the bottom of the sluice.

BKH, a chain fixed to the cylinder GH at H, thence passing over the pulley K, has its other end fixed to the sluice BD at B.

When the water in the canal, river, or pond, rises to the line BC, it passes into the cylinder EF, at the small holes IIII; and this lessens the weight of cylinder GH so much, that the pressure of the water in front of sluice BD throws it open. When the water subsides, so as not to enter these holes, the cylinder is emptied by the tube EL, and then the weight of the cylinder GH shuts the sluice as before. The dimensions and weight of this cylinder must of course correspond with the weight of the column of water pressing upon the sluice BD. An apparatus of this kind was first erected at Rothesay in 1817. The dimensions of one of these are:—cylinder GH two feet diameter, and two feet deep over all; weight 500 lbs.* Cylinder EF five feet ten inches deep, two feet one inch diameter inside: sluice BD four feet long and two feet deep.

This sluice is here represented with the pivots on which it turns at its under edge, but they may be placed either at the upper or under edge, as circumstances render advisable. The upper edge is also here represented on a level with high-water mark, but if necessary, it may be placed any where between that and the bottom of the pond or aqueduct, or right below, as on an aqueduct bridge, or similar situation. The cylinders may also be placed on the outside of the dam or embankment by having a pipe to communicate between them and the water within; but in whatever situation the sluice or cylinders may be placed, the pipe that communicates between the cylinders and the water within the embankment must always have its opening there exactly at the level of high-water mark, or at the greatest height to which the water therein is to be permitted to rise.

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* This weight is considerably more than necessary when the sluice is placed with the pivots at its under, and the chain at its upper edge; but it was calculated to be powerful enough when the sluice was turned with the pivots at its upper and the chain at its under edge, to which position it has since been changed.

Although the cylinder GH requires to be heavier to shut the sluice when its pivots are at the top, yet, to pass the same quantity of water, it does not require to move half so far as when they are at the bottom, and therefore the cylinder EF may be made much shorter; so that the cost in either case is nearly the same, or rather in favour of the pivots being at the top. In most cases this last position is preferable; there are instances, however, in which the other is more advisable, such as in a river where wood, ice, or other bulky substances may be expected to float occasionally on the surface; but such cases require a particular construction adapted to the circumstances.

On this principle a self-acting dam may be raised in any river or stream, up to high-water mark, by which means a considerable reservoir will be obtained, whilst, during floods, the dam will fold down, and no new ground be overflowed.

In lawns or pleasure grounds, through which streams or rivulets flow, these sluices might be applied to advantage; for by placing one on the bank of each pond, the water within would always be kept at the same height, whether the weather were wet or dry; and hence flowers or shrubs might be planted close to the water's edge, or in it, (as best suits their respective habits,) and their position with regard to water would always be the same.

PLATE II. *Figure* 7. A.

This is merely a different construction of the waster sluice figure 7.

AB is the sluice which turns on pivots at the upper edge A.

CD, a lever attached to that sluice.

E, a hollow can of cast iron attached to the extremity of that lever at D, and into which small stones are put until it becomes heavy enough to shut the sluice against the pressure of the water in front.

F, a pulley.

G, a hollow cylinder of copper (or tin-plate painted,) with a small aperture in its bottom.

DFG, a chain, one end of which is fixed to the lever at D, then, passing over the pulley F, has its other end fixed to the cylinder G.

AH, a tube which communicates between the water in front of the sluice AB and cylinder G.

When, therefore, the water in front of the sluice is not so high as to flow along the tube AH, the sluice AB remains shut, but when the water rises so as to flow along that tube, it fills the cylinder G, which then descending, raises the lever CD and can E, and opens the sluice. Again, when the water falls so as not to flow along the tube AH, the cylinder G is emptied by the small aperture in its bottom, and then the can E shuts the sluice. I erected a sluice of this construction in 1821, at Cartsburn-mill, Greenock. The sluice is four feet long, two and a half feet deep; the lever five feet long from B to D, the cylinder E sixteen inches diameter, and eighteen inches deep, and filled with small stones till it weighs two hundred and sixty pounds.* The cylinder G is eighteen inches deep, and the same diameter. This method, wherever it can be adopted, is preferable to that of Fig. 7; being simpler and less expensive in the construction.

Art. XIX.—*Description of an Extraordinary Parhelion observed at Gotha on the* 12*th May*, 1824.

This very singular parhelion appeared at Gotha on the 12th May, 1824, and was seen at several places around that city. It was seen at Meinengen, eight leagues from Gotha, but not a trace of it was observed at Bamberg, which is twenty-four leagues from Gotha.

This parhelion was observed by M. de Hoff, by Dr. Buch, of Frankfort, who happened to be at Gotha, and by Professor Kreis. Unfortunately, however, none of these gentlemen measured the arches of the phenomenon with a sextant; but there is reason to think that the drawing of it sent by M. de Hoff to Baron Zach, which we have given in Plate II. Fig. 14. and his description of it, from which we have made the following abstract, are tolerably correct. This drawing was taken at half-past seven in the morning, when the apparent height of the sun was 24° 51′. At this time the parhelion S''' appeared in the horizon, so that the radius of the interior circle SS''' was a little less than 24° 51′. The radius $SG = SA = SB$

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* The quantity of water pressing upon the sluice is twelve and a half cubic feet, or 781 lbs. The pressure at the upper edge of the sluice is to that at its under edge as 8 to 22 nearly; therefore the pivots of the sluice support 208 lbs. which leaves 573 to be supported by the can E; but there is a lever power of two to one, which reduces this weight one half, or to 286 lbs. The weight of the lever CD itself is equal to about 30 lbs. more than the weight of the empty cylinder G; so that the whole weight of the can E requires only to be 260 lbs.

appeared to be double of the radius of SS‴. The part of the sky occupied by the sun was covered with small light clouds. It was quite clear and blue in the Zenith. In the sky opposite to the sun there were also very small, white, detached clouds, upon which the parhelion appeared, being always interrupted in the clear and blue sky.

The true sun appeared at S, and was surrounded by a circle of shining light S′ C S″ S‴. M. Kreis observed that this light was *yellow*, and the interior margin red.

Two parhelia appeared at S′ and S″, a little out of the circle S′ C S″ S‴, and at the same height as the true sun S. They were very bright, and shone with all the colours of the rainbow. The red being nearest to the sun, and the green on the opposite side, and they terminated in small tails below the false suns.

A third parhelion appeared at S‴. It was less brilliant than the others, and did not appear in the horizon till between 7½ʰ and 8ʰ. An arc of a great circle ADFB, truncated on A and B, showed at D and F very lively colours of the rainbow. At its extremities, A and B, and at the other part DF, it was whitish; but the whiteness could be easily distinguished from the colour of the sky. In these two arcs the red colour was always next the sun, and the green on the opposite side; the centres of the two circles were, the one on the side of the sun, and the other on the opposite side. Dr. Buch, who observed the parhelion a quarter or half an hour before M. de Hoff, saw a great portion of the circle DCF turned upwards. Professor Kreis, instead of one arc, saw two, which intersected in C, as shown in Fig. 15. The point C appeared to him extraordinarily brilliant, but without any image of the sun.

There was also a great circle, AHGIB, concentric with the small one, S′ C S″ S‴, the upper part of which shone with the most brilliant colours of the rainbow. The *red* was still turned towards the sun. The rest of that circle appeared to M. de Hoff white, but M. Kreis remarked, near the horizon, the colours of the rainbow. A part of the circle dipped under the horizon, cutting the two circles ADFB and AS′SS″B at the same point A and B. Its radius appeared to be double that of the circle S′CS″S‴.

Another circle KGL appeared with very brilliant colours, and, touching the circle AHGIB in the point G, the *red* of its outer border being turned towards the sun, and the *green* being in its inner circumference. This circle seemed to me to have a radius smaller than that which immediately surrounded the sun. It is possible, however, that, from an optical illusion, they might appear of different sizes, though their magnitude were the same. The upper circle KGL was not complete, from the want of white clouds to receive it; but at the part where it touched the other circle, and at some distance beyond its two sides, the colours had an extraordinary brilliancy.

The Zenith was nearly at Z. A great shining circle $S\ S''''\ S'''''\ S''''''$ passed through the centre of the true sun and the two parhelia S' and S''. It was parallel to the horizon, and had its centre in a line which passed from the Zenith to the Nadir. The two parhelia $S'\ S''$ were confounded with the small tails opposite to the sun. The parhelia appeared at A and B.

This great horizontal circle did not appear at the beginning of the phenomenon. Some parts of it appeared at the parhelia. It was quite entire at 7^h.

Three parhelia $S''''\ S'''''\ S''''''$ appeared upon this great circle; the two first being 90° from the real sun, and the last 180°. They were white and their light feeble.

Two luminous arches OP and QR, which seemed to be portions of two great circles cut the false image of the sun at right angles. M. Kreis saw them differently, as shown in Fig. 16. He says that they crossed the horizontal arch nearly in a vertical direction.

Professor Kreis observed the portion of a circle $MS'''N$ a little after seven o'clock, and Dr. Buch saw it re-appear nearly at eight o'clock.

This singular parhelion began to appear at $6\frac{1}{2}^h$, M. de Hoff saw it at three quarters of an hour after 6. At 7^h in the morning the barometer stood at 27 inches 1 line 4. At 5^h in the morning the thermometer was +2° Reaumur, 36½° of Fahrenheit, so that at no great height in the atmosphere the temperature must have been so low as freezing.

Art. XX. — *On the Botany of America.* By William Jackson Hooker, LL.D. F.R.S.E. Communicated by the Author.

In noticing, as we propose to do, the progress of botany, and the present state of that science in various parts of Europe, it is by no means our intention to pass by in silence what has been effected by our brethren in North America, a country which, for extent and interest, has scarcely any parallel in the world. If we were to estimate it from its southern extremity, we should commence our calculations at the tenth degree of north latitude; but as we shall confine our observations to those districts which have submitted to the sway of the United States, or to those which may, with more propriety, be termed the British possessions in North America, we shall omit the Mexican dominions altogether; and beginning with the thirtieth degree of latitude, we have a space extending northward beyond the arctic circle; and if we include the island of Newfoundland, through eighty degrees of longitude in its utmost breadth. The vegetation is as various as are the climate and the soil, throughout this vast extent of continent. In the Floridas grows a majestic species of *Palm, (Chamærops Palmetto,)* and the *Orange*, the *Cotton*, the *Indigo*, and even the *Sugar cane* may be cultivated there to great perfection and advantage. In the Carolinas and the Floridas the eye of the traveller is charmed with the beauty and grandeur of the forest trees, the various species of *Evergreen oak*, the numerous kinds of *Pine*, *Walnut*, and *Plane;* the majestic *Tulip tree (Liriodendrum tulipiferum)*, reaching to the height of 140 feet, and loaded with large and brilliant flowers, the curious *deciduous Cypress*, and the superb *Magnolias.*

A different vegetation occurs in the more northerly of the United States; and what renders the botany of North America peculiarly interesting to the British naturalist is, that a very large proportion of its vegetable productions may be assimilated to our own climate. This is especially the case with that extensive portion of it under our immediate consideration. The *Oaks* and *Firs* of this district of North America now decorate many of our plantations and pleasure grounds, and as the quality of their timber comes to be better known and appreciated, they will doubtless occupy a conspicuous place in our woods and forests. Our shrubberies owe their greatest beauty to the various species of *Kalmia, Azalea, Rhododendron, Robinia, Cornus, Sambucus, Ceanothus,* and *Lonicera,* to the *Syringa,* the *flowering Raspberry,* and a hundred others, which flourish as if they were the aboriginal natives of our soil; whilst the gardens of the curious are indebted for many of their choicest productions to the herbaceous plants of North America, the greater number being remarkable for the brilliancy of their blossoms, and not a few, such as the *Dionæa* and *Sarracenia,* striking us as amongst the most singular of all vegetable productions in their structure. Nay, such is the superiority of the climate, and the fertility of the soil, that our European fruits, which were taken over by the early settlers, have improved prodigiously in quality; to that degree, even that we now procure grafts of them for our orchards and wall-trees; and the most highly flavoured apples that we (north of the Tweed at least,) can obtain for our desserts, are actually imported themselves from America.

In the arctic regions of the New World, there is a striking similitude in the botanical productions with those of the summits of our highest Scotch mountains.

The earliest accounts of the plants of North America consist of detached memoirs, principally published by foreigners, the Americans being themselves, for a long time, too much occupied in commerce and agriculture to devote their time and attention to science; nor is it till a country has arrived at that degree of political and mental improvement to which we find the United States now to have attained, that we can expect any branch of science to be estimated as it deserves.

A small history of the *Plants of Canada* by Cornuti appeared in Paris in 1635. About the year 1740 was published Catesby's *Natural History of Carolina,* &c. in 2 vols. large folio, illustrated with a great number of highly coloured figures of plants, &c. Gronovius edited the *Flora Virginica* of Clayton, at Leyden, in 1739. In the Memoirs of the American Academy, Dr. Cutler printed his Account of the

Vegetable Productions of the New England States; and, in 1788, *Walter's Flora Caroliniana* appeared in London.

The elder Bartram, during his extensive and interesting travels, discovered many curious plants, and was the means of making them known to the botanists of Europe, especially of Britain. His friend and patron, Mr. Peter Collinson, who kept up a constant correspondence with him, Colden, and other naturalists of America, was one of the first to cultivate the plants of that country in England, which he did with much success, at his charming garden at Mill Hill, near London. Dr. Garden was another eminent promoter of American botany, and in his communications to Linnæus, he sent many new and interesting plants. His botanical enthusiasm seems to have been very great; and we have some striking proofs of it lately published by Sir J. E. Smith, in the Linnæan correspondence. In one of those letters, addressed to the illustrious Swede from South Carolina, Dr. Garden thus expresses himself on the occasion of his being disappointed of an intended journey to the Apalachee mountains, by an order for the expedition to return. "In my letters," he says, "to you at that time, I gave you an account of my intended journey, and in what manner the arrival of our new governor put a stop to us. Good God! is it possible to imagine the shock I received when the unhappy express overtook us, just two days march on this side of the mountains. My prospect of glutting my very soul with the view of the southern parts of the Great Apalachees was instantaneously blasted. How often did I think of the many happy hours that I should have enjoyed in giving you a detail of their productions. How often did I think of the secret pleasure which I should have, in being instrumental, though in the least degree, to the advancement of our knowledge of the amazing works of the Supreme Architect. How happy should I have been to have thrown in my mite, by adding one new genus or species to the vegetable or mineral kingdom. With what pleasure did I bear the sun's scorching beams, the fatigue of travelling, the cold ground for my pillow, and the uncomfortable dreariness of rain, when I had in view the wished-for examination of the productions of the mountains. We had advanced about 260 miles of our journey through the woods, when our hour was come that all our promised Elysium vanished, and left nothing but a blank, a doleful blank to me, and I may say to every one of the company; for we were happily collected, and unanimity reigned amongst us. What will you think when I tell you that one of our company was a very accurate drawer, and he had promised me to do every thing for me, and according to my direction, that I should desire; so that, in this one circumstance, my loss was irreparable. But why do I dwell on the most disagreeable of all the incidents that ever Providence mingled in my lot?"

Kalm, the celebrated pupil of Linnæus, who was also Professor of Natural History at Abo, in Finland, visited America at the expense of the king of Sweden, in the years 1747—51. His researches extended so far as Canada, and the plants which he collected served materially to enrich the *Species plantarum* of his great master; while the Linnæan herbarium, as Sir J. E. Smith assures us, abounds in specimens brought home by Kalm, and distinguished by the letter K. The name of this botanist is commemorated in the beautiful genus *Kalmia.*

Until the year 1803, however, nothing had been published containing a thoroughly scientific arrangement of any extensive portion of the northern part of the New World. The providing of materials for such a work was reserved for André Michaux, a Frenchman, every way qualified for the task, and who, after returning from a most successful botanizing expedition to Persia, and bringing with him, amongst other treasures, the curious *Rosa simplicifolia* and *Michauxia campanulata,* was appointed to visit North America at the charges of the French government, with a view to enrich France with its various vegetable productions, particularly its forest trees; for which, it must be confessed, that the climate of that country is even better qualified than that of England.

New York Michaux constituted the depot for the collections which he made through New Jersey, Pennsylvania, and Maryland; and he there established a garden, from whence he dispatched numerous packages to France. Another depot was formed at Charleston, for the reception of the productions of the Carolinas and the Alleghany mountains, which he explored with great difficulty and danger, travelling no less than

900 miles across the wilds of Carolina and Georgia alone. Thence he visited Spanish Florida, making his way up the rivers for considerable distances, in a canoe hollowed out from a single trunk of the deciduous *Cypress (Cupressus disticha.)* In May 1789, he investigated the mountains of Carolina, and, assisted by some Indian guides, without whom it would have been impossible to have made any progress, he penetrated the vast woods of the intervening plains, through thickets of *Rhododendron*, *Kalmia*, and *Azalea;* but was prevented from going so far as he had intended, in consequence of a dispute between the Indians and the white people, which rendered it unsafe for Europeans to venture among the former. He therefore returned to Charleston by New York and Philadelphia. He now recommended and instructed the Americans to collect and prepare the root of the *Ginseng (Panax quinquefolia,)* in the same manner as the Chinese do for sale; and, for a long time, a trade was actually carried on with China in that article.

Michaux had still another object in view, which was that of tracing the botanical topography of America; and, having effected so much in the southern States, he resolved to extend his researches as far north as Hudson's Bay. In short, he arrived at a country, where, as he says himself, "nought but a dreary vegetation was found, consisting of black and stunted pines, which bore their cones at four feet only from the ground; dwarf *Birch* and *Service Trees*, a creeping *Juniper*, the *Black Currant*, the *Linnæa borealis*, *Ledum*, and some species of *Vaccinium*."

Michaux did not return to Europe till 1796, when he was shipwrecked on the coast of Holland. The circumstance is thus related by his biographer in the third volume of the *Annales du Muséum d'Histoire Naturelle.* "The passage had not been unpropitious; but on the 18th of September, when in sight of the shores of Holland, a dreadful tempest arose; the sails were rent, the masts broken, and the vessel struck and split against the rocks. Such was the state of exhaustion and fatigue to which all the sailors and passengers were reduced, that the greater number would have been lost, but for the assistance that was rendered by the inhabitants of Egmond, a little neighbouring village. Michaux was lashed to one of the yards, and he was senseless when carried on shore; he did not recover till some hours after, when he found himself extended before a fire, with more than fifty persons standing around him. His first idea, when his recollection returned, was to inquire for his collections. He was informed that the packages which contained his own effects had been lying on deck, whence they were washed by the violence of the waves; but that those chests which had been lodged in the hold had been taken out safely. This intelligence consoled him. Notwithstanding the wretched state of his health, Michaux was compelled to remain six weeks at Egmond, and to work day and night. His plants having got wetted by the salt water, he was obliged to immerse them all in fresh water, and one after another, to dry them between new papers."

On his return to his native country, Michaux employed himself in preparing his *History of Oaks*, a work which reflects the highest credit upon its author; not only because of the number of new species which are there made known to us, but also on account of the important uses to which the timber of the different kinds may be applied. An appointment to explore other countries * prevented him from publishing himself any of his various new and important discoveries. His *History of the Oaks* was indeed printed, but the plates were not all ready for the press before his departure from Europe. It was edited in 1801. But that work which more immediately concerns our present subject, and which was compiled from the materials that he collected during his travels in North America, is his *Flora Borealis Americana, sistens Characteres Plantarum quas in America Septentrionali collegit et detexit Andreas Michaux.* This appeared in 1803, (the very year of Michaux's death,) in two volumes octavo, with fifty-one neat plates in outlines. The anonymous editor, and indeed he may justly be considered the author, was the eminent Claude Louis Richard, late professor of botany at the School of Medicine in Paris, and unquestionably one of the most profound botanists that Europe has ever known. The whole is in Latin, and, as may be supposed, the proportional number of new species is extremely large, and certainly considered as the first Flora of so extensive a country as North America; it confers the highest credit on the industry and acuteness of Michaux.

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* He embarked in the ill-conducted expedition under Captain Baudin; but like many others of the officers, when the vessel arrived at the Isle of France, he refused to proceed farther, and thinking that Madagascar presented a glorious field to the naturalist, he quitted the expedition; keeping his motives a secret till the moment of the ship's departure. Landing on the east coast of that island, he resolved to prepare a garden for the reception of his plants in the vicinity of Tamatada; but here he was seized with a fever, the consequence of the climate, aided by over-exertion, and of which he died in 1803.

Long before the publication of this work, another naturalist, Frederick Pursh, a Pole, we believe, by birth, but educated in Dresden, instigated by the richness of the vegetation, and the hope of making numerous discoveries, resolved to visit North America, and carried his plan into execution in 1799, when he embarked for Baltimore, in Maryland, with the resolution not to return to Europe till he had examined the country, and collected materials to the utmost extent of his means and abilities; and it is certain that he did this under many and great disadvantages. His travels were extensive; for he remained nearly twelve years in America, and in two summers only he went over an extent of country equal to 6000 miles, principally on foot, and with no companion save a dog and his gun. From the first four or five years of his residence in America, Pursh seems to have been chiefly employed in collecting plants about Philadelphia, and in receiving them from his correspondents for cultivation in his gardens there. In 1805, he explored the western territories of the southern states, including the high mountains of Virginia and Carolina; and in 1806, he went through many of the northern States, commencing with the mountains of Pennsylvania, and extending his investigations to those of New Hampshire, embracing the country of the lesser and great lakes.

But the most important of the advantages to which I allude, were derived by Pursh's personal acquaintance with, and communications from, various botanists, who about this time were to be found in different parts of the United States.

Among these, the first undoubtedly in point of rank and character, will stand the amiable Dr. Muhlenberg, minister of the German church at Lancaster, in Pennsylvania. He was thoroughly conversant with the vegetable productions of his own district, and in a measure with those of America generally: for he published, in 1813, a *Catalogue of the Plants of North America*, which contains a great number of new species; and what redounds still more to his credit, though it was a posthumous work, he was the author of an excellent treatise on the *Grasses and Sedges of North America*, which was edited in 1817 by his son, assisted, as he tells us in the preface, by Mr. Elliott, Mr. Baldwin, and Mr. Collins. This work is entirely in Latin. Dr. Muhlenberg carried on a most extensive correspondence with the botanists of Europe, by whom he was greatly esteemed. He supplied the celebrated Hedwig with many of the rare American mosses, which were published either in the *Stirpes Cryptogamicæ* of that author, or in the *Species Muscorum*. To Sir J. E. Smith, and Mr. Dawson Turner, he likewise sent many plants, and one of his new mosses was published by the latter gentleman in the *Annals of Botany*, under the name of *Funaria Muhlenbergii*. It is well known that Dr. Muhlenberg possessed very extensive materials for a general description of the plants of the New World; but what has become of these we have been unable to ascertain. His herbarium is in the possession of the American Philosophical Society.

Another of the friends of Pursh was Dr. B. Smith Barton, a physician and a naturalist, and unquestionably a great promoter of Science, and especially of Botany in America. He was appointed Professor of Natural History in the university of Philadelphia in 1789. We recollect, in our early youth, reading with great delight some of his *Fragments of Natural History*, as they were appropriately termed, which first brought to our notice many highly curious objects of that country, and reminded us of the writings of our own Stillingfleet and White. He has the credit of publishing an elementary work on Botany, which, though rather diffuse in style, is full of entertaining anecdotes; and the references and terms being all made applicable to American plants, it must have done much towards recommending the study of botany in that country.

Mr. Marshall, author of a work on the forest trees of America, was then living, and he imparted to Pursh some useful materials, principally afforded by his garden, rich in trees and shrubs.

The sons of the celebrated John Bartram, before mentioned, possessed an old established garden, founded indeed by the elder Bartram, at Philadelphia, on the banks of the Delaware. Mr. William Bartram, the well-known author of the travels through North and South Carolina, was then, and we believe is still living; a man who merits the gratitude of every naturalist, for the cordial reception which he gave to Wilson, the ornithologist, at the period when that highly-gifted individual had scarcely a friend in the world. It was the advice and encouragement that Mr. Bartram gave him that was mainly the cause of the appearance of one of the most valuable works on science that was ever published in any country, the *American Ornithology.** Mr. Pursh appears to have received an equally kind reception and much valuable information from Bartram.

In 1802, Mr. Pursh had the charge of the extensive gardens of W. Hamilton, Esq. called the Woodlands, which having, immediately previous, been under the charge of Mr.

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* We cannot help here, though but little connected with the subject of this paper, making an extract from the interesting life of Wilson, published by Mr. Ord, in the 9th volume of the *American Ornithology.* "His residence being but at a short distance from the botanical garden of Messrs. Bartram, situated on the western bank of the Schuylkill, (a sequestered spot, possessing attractions of no ordinary kind,) an acquaintance was soon contracted with that venerable naturalist, Mr. William Bartram, which ripened into an uncommon friendship, and continued without the least abatement until severed by the hand of death. Here it was that Wilson found himself translated, if we may so speak, into a new existence. He had long been a lover of the works of nature, and had derived more happiness from the contemplation of her simple beauties, than from any other source of gratification. But he had hitherto been a mere novice; he was now about to receive instructions from one whom the experience of a long life, spent in travel and rural retirement, had rendered qualified to teach. Mr. Bartram soon perceived the bent of his friend's mind, and its congeniality to his own, and took every pains to encourage him in a study, which, while it expands the faculties and purifies the heart, insensibly leads to the contemplation of the glorious author of nature himself."

Lyon, an Englishman, and an eminent collector, were found to be enriched with a number of new and valuable plants; and Mr. Pursh affirms, that through Mr. Lyon's means, more rare and novel plants have been introduced from thence to Europe than through any other channel whatever. The herbarium, as well as the living collection of Lyon, was of great use to Mr. Pursh; and the plants described by him, from specimens seen only in that herbarium, are numerous.

The interesting expedition of Messrs. Lewis and Clarke across the vast continent of America to the Pacific Ocean, by the way of the Missouri and Great Columbia rivers, was productive of a small collection, of about 150 species of plants, (but of which not a dozen were previously known to the natives of America,) which Mr. Pursh had the opportunity of describing. These were gathered during the rapid return of the expedition from the Pacific Ocean towards the United States. A far more extensive herbarium had been formed by the same expedition on the ascent towards the Rocky Mountains, and among the chains of the Northern Andes; but this was lost, in consequence of the inability to carry it beyond a certain point.

Another set of specimens to which Mr. Pursh had free access, was that belonging to Mr. Ensley, a German naturalist, who had been sent out to America by Prince Lichtenstein. It was particularly rich in the vegetable productions of Lower Louisiana and Georgia.

Thus, by Mr. Pursh's personal exertions and industry, and by the aid of other botanists, he found himself about the year 1807, in possession of materials for a Flora of North America, amounting to nearly double the number of species enumerated by Michaux. He began seriously to think of publishing them, and applied to some bookseller in Philadelphia for that purpose; but his intention was deferred in consequence of his being called upon to take the management of the public Botanic Garden at New York, originally established by Dr. David Hosack, and his private property. Here, again, keeping his favourite object respecting the publication of a Flora in view, he had the opportunity of adding farther to his knowledge of the plants of the United States, and of obtaining still greater assistance, particularly from M. le

Comte of Georgia, and from the estimable Professor Peck[*] of New Cambridge University.

Fortunately for the cause of science, there existed at the time of which we are speaking, so many obstacles to the publication of scientific works in America, that Mr. Pursh was led to visit England, where the reception he met with from Sir Joseph Banks, and A. B. Lambert, Esq. made him resolve upon printing his book in this country. The access which was granted him to the Libraries and collections of these two eminent men, were alone a source of much advantage to him. He had also the opportunity of examining, amongst others, the select Herbaria of *Clayton*, in the Banksian collection, from which the *Flora Virginica* was formed; of *Walter*, from which the *Flora Caroliniana* was compiled, in the possession of Messrs. Frazers of Sloan Square; of Catesby, part of which is in the British Museum, whilst another part, together with numerous additions from Walter, Michaux, J. Bartram, and a Mr. Filden, from Hudson's Bay, is in the Sherardian Herbarium at Oxford; that of Plunket, in the British Museum; of Pallas, (in the possession of Mr. Lambert,) rich in the vegetable productions of northern Asia, which, as is well known, bear a great affinity to those of the northern parts of America; of Mr. Bradbury, which was formed in Upper Louisiana, in the possession, we believe, of the Botanic Garden at Liverpool; and of A. Menzies, Esq. which was selected, during that gentleman's voyage with Captain Vancouver, upon the N. W. coast of America. Nor should the various collections be omitted which are found in the gardens of England, especially in the vicinity of London.

Thus prepared, the *Flora Americæ Septentrionalis*, or a

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[*] We recollect when, many years ago, this gentleman did us the honour of a visit in England. He mentioned that his taste for natural history was induced by the perusal of an *imperfect* copy of Linnæus's *Systema Naturæ*, a work then scarcely known in America, and which he obtained from the wreck of a ship which was lost near the spot where he resided. Professor Peck afterwards became eminent, particularly for his knowledge of insects; and his communications to our great entomologist, the Rev. Mr. Kirby, are highly valuable. Many of these were published by Mr. Kirby, in the Transactions of the Linnæan Society, and amongst them the curious *Xenos Peckii*, an insect which inhabits the joints in the abdomen of the *Wasp*. Another insect nearly allied to this is the *Stylops Melitta* of Mr. Kirby's *Monographia Apum Angliæ*, and which inhabits the same situation in the body of the *Honey bee*.

Systematic Arrangement and Description of the Plants of North America, by Fk. Pursh, appeared in London in the year 1813, with 24 well-executed plates of new species, in 2 vols. 8vo. The specific characters are in Latin, the observations in English.

The arrangement is that of the sexual system; but the author has made considerable deviations from the generally received arrangement of the Linnæan school. The classes *Dodecandria* and *Polyadelphia* are omitted, as well as *Monœcia, Diœcia* and *Polygamia* and their genera are referred to other classes, some according to the number of stamens, others to his 19th class, which is called *Declinia*, and which contains *Euphorbiaceæ*, *Amentaceæ*, and *Coniferæ*; thus bringing into his arrangement an union of a natural and artificial system, which has not been adopted by others.

Michaux's work included the whole of the class *Cryptogamia*; but this, though all perhaps that was then known, contained so scanty a list as scarcely to deserve notice. Mr. Pursh professes to go no farther than the order Filices of the class Cryptogamia.

Sometime after the publication of his Flora, the author again visited America, but with a view of confining his researches to a part which had been very little explored, namely Canada. There he died in 1820. His herbarium of that country, which was considerable, has been purchased by Mr. Lambert, who, we believe, is also the possessor of that far more extensive and valuable one which Pursh had made in his former travels in the United States.

In the year 1814, there appeared in America, printed at Boston, the *Florula Bostoniensis*, or a Collection of Plants of Boston and its environs, by Jacob Bigelow, M.D. in 1 vol. 8vo. It is in English, and strictly arranged according to the Linnæan system. It was destined principally for the use of the students in Botany; and the plants described therein were all collected during two seasons, in the immediate vicinity of Boston, or within a circuit of from five to ten miles; and although very few new species are added, the number of individuals is very considerable for so limited a space.* During the year 1816, accompanied by our valued friend Dr. Francis Boott, Dr. Bigelow examined the botany of the White Mountains in New Hampshire, and published an account of it in the *New England Journal of Medicine and Surgery* for that year. This was one among many other journies made by these gentlemen in the New England States, with a view to the publication of a Flora of that district. The design, however, has been relinquished, and the principal cause, since it has arisen from Dr. Boott's naturalization among us, we ought not to regret. Science, however, has been a sufferer; for, from our personal knowledge of this gentleman, we are satisfied that he would have been a most able and zealous coadjutor in such an undertaking. A very extensive collection of the plants of that country has been liberally presented to us by Dr. Boott, which has satisfied us, that in the art of preserving specimens, no one has ever exceeded, or perhaps ever equalled him; and the names are very frequently accompanied by valuable notes.

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* At the moment of our sending these notices to the press, we have received from its esteemed author, who is a Professor in Harvard College, New

It is delightful to see a man, of the talents and rank in life of Mr. Elliott of Charleston, the excellent President of the Literary and Philosophical Society of South Carolina, deeply engaged in important public affairs; yet cheerfully devoting his leisure hours to the promotion of the arts and of science, and actually engaged in publishing a Flora, under the unassuming title of a *Sketch of the Flora of South Carolina and Georgia*, which he commenced in 1816. This is arranged according to the Linnæan system, having specific characters both in Latin and in English, and very copious notes and descriptions. A work thus conducted cannot fail to be of great importance to the student of American botany; the more so, since the author has written from his own personal observation, depending little upon the assistance of others, and in a capital where science has not been so much cultivated as in the northern States. In a letter now before us, the author says, "No one in Europe can, probably, appreciate correct-

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Cambridge, a second edition of the *Florula Bostoniensis*, containing about twice the number of plants enumerated in the first edition, and also many valuable remarks, particularly on the useful natures and qualities of the species. Dr. Bigelow is also the author of a valuable work, entitled, *American Medical Botany*, begun in 1817, of which three parts have reached us.

ly the difficulty of the task in which I have engaged. The want of books, the want of opportunities for examining living collections or good herbaria, the want of coadjutors, have all served to render my task arduous, and to multiply its imperfections." Nevertheless, there are many new species, described with great care and fidelity, and the grasses, which are accompanied with some neat plates, have particularly attracted the author's attention. There are several beautiful novel species, and some newly established genera. We have received of this work to the 6th No. of the 2d volume, which includes so far as the class *Monœcia;* and we are informed by Mr. Elliott, that another number will complete the *Sketch.* This we regret, as the work cannot thus take in the *Cryptogamia;* and we consider Mr. Elliott's talent for minute description admirably calculated for such plants as that class embraces. No man seems to be more strongly impressed with the value of the study of natural history than Mr. Elliott. "It has been, for many years," says he, "the occupation of my leisure moments; it is a merited tribute to say, that it has lightened for me many a heavy, and smoothed many a rugged hour; that beguiled by its charms, I have found no road rough or difficult, no journey tedious, no country desolate or barren. In solitude never solitary, in a desert never without employment. I have found it a relief from the languor of idleness, the pressure of business, and from the unavoidable calamities of life."*

We come now to the agreeable employment of mentioning a very important work, both on account of the extended nature of the publication, and of the manner in which it has been executed; we allude to the "*Genera of North American Plants, and a Catalogue of its Species to the year* 1817, *by Thomas Nuttall,*" in 2 vols. 12mo. printed at Philadelphia. Mr. Nuttall is an Englishman by birth, and a native of Yorkshire; but he visited North America at an early age, and is now domiciliated in that country. His love of botany and mineralogy is exceedingly great, and a personal acquaintance, which his late visit to this country has enabled us to have the pleasure of forming, has only served to increase the esteem and respect which his writings had already taught us to entertain towards him. For many years previous to the publication of his Flora, the author was engaged in visiting very extensively the territories of the United States, particularly the southern and western ones. "For nearly ten years," he says in his preface to his *Journal of Travels into the Arkansas territory*, "I have travelled throughout America, principally with a view to becoming acquainted with some favourite branches of natural history. I have had no other end in view but personal gratification; and in this I have not been deceived; for innocent amusement can never leave room for regret. To converse, as it were with nature, to admire the wisdom and beauty of creation, has ever been, and I hope ever will be, to me a favourite pursuit; and to communicate to others a portion of the same amusement and gratification has been the only object of my botanical publications."

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* See Elliott's address to the Literary and Philosophical Society of South Carolina, delivered at Charleston, and published there in 1814.

The "*Genera of North American Plants*" is entirely in English; and it appears that it was the design of the writer to have arranged it according to the natural orders. But out of deference to public opinion, in a country where the artificial system of Linnæus had almost exclusively been studied, Mr. Nuttall adopted that method. He has, however, made a great many valuable remarks upon the natural orders, following several of the genera, and has recommended the adoption of some new ones. He has well defined the characters of the order *Monotropeæ*, to which he has properly referred the highly curious *Pterospora*. As, however, the well-known genus *Pyrola* belongs unquestionably to the same family, the term *Pyroleæ* might perhaps have been considered as more appropriate. The characters of the genera (which he here extends to 807, exclusive of any cryptogamia,) have, as may be inferred from the title, occupied a greater share of attention from Mr. Nuttall. He has added to the essential characters, those taken from the habit of the plant, and he has noticed their geographical distribution. In the enumeration of species, he has included all that have been described by other authors, sometimes made observations upon them, and added a very considerable number of new individuals, which have been discovered by himself or his friends. This book may therefore be well said to form an era in the history of American botany; and we rejoice that the execution of it has fallen into such able hands.

Mr. Nuttall has added still more to his credit as a naturalist and a man of most acute observation, by the publication of his *Travels in the Arkansa Territory.* This was a journey accompanied with great difficulty, and not a little danger. The plants which he collected were numerous and interesting, very different from the vegetation of the rest of the United States, and many of them perfectly new. Some detached accounts of the botany of this singular district have already appeared, particularly in the *Journal of the Academy of Natural Sciences at Philadelphia*, and not a few of the plants themselves are now cultivated in our botanic gardens, from seeds gathered by Mr. Nuttall.

This gentleman now occupies the chair of Natural History in the University of New Cambridge.

We regret not to be able to give any account of *Eaton's Manual of Botany*, nor yet of *Barton's* more extended *Flora of North America*, (which is, we believe, in the course of publication,) never having had the opportunity of seeing these works.

The various scientific journals which are published in America, contain many memoirs upon the indigenous plants. Among the first of these in point of value, and we think also the first with regard to time, we must name *Silliman's American Journal of Science*, in which we find Botanical Tracts by Professor Ives of Yale College, and Mr. Rafinesque, by Dr. Torrey, a physician at New York, "On the plants collected by D. B. Douglass of West-Point, in the expedition around the great lakes, and the upper waters of the Mississipi, under Governor Cass, during the summers of 1818—20;" and also "on a new species of *Usnea** from

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* Dr. Torrey did not possess the fructification of this plant. We were so fortunate as to obtain a specimen of it through the kindness of Mr. Edwards, late surgeon of the Hecla, which came from the same country, and has fine shields. It is one of the handsomest species of *Usnea* that we are acquainted with; but it certainly approaches very near the *U. sphacelata* of Brown, from the Arctic regions. Dr. Mitchell, who communicated the plant to Dr. Torrey, seems inclined to believe this lichen to be the only vegetable production of New South Shetland. We have received half a-dozen different ones, and will venture to predict that many more will yet be discovered.

New South Shetland," (*U. fasciata* of Torrey,) by Mr. Lewis de Schweinitz, in a valuable "Monograph of the genus *viola*," by Mr. Nuttall, on a "collection of plants made in East Florida, by Mr. Ware," by Mr. M. C. Leavemvorth, on "four new species of plants from Alabama," by Professor C. Dewey of William's College, upon "*Carices*."

In the *Journal of the Academy of Sciences*, the Botanical Memoirs are entirely from the pen of Mr. Nuttall.

The *Annals of the Lyceum of Natural History of New York* were only commenced last year; but the numbers, (of which we have received five from that excellent institution,) contain several communications on the subject of botany. In No. I. is a "Synopsis of the Lichens of the state of New York," by Mr. A. Halsey, and a description by Dr. Torrey of "some new and rare plants collected in the rocky mountains, during the expedition thither, commanded by Major Long, by Dr. Edwin James;" in No. II. a "Synopsis of the *Carices*," by Dr. Schweinitz. No. III. contains an article "on the American *Utriculariæ*," by M. le Comte, who enumerates 11 species. No. IV. "on the genus *Gratiolia*," by the same author. No. V. "on the genus *Ruellia*," by M. le Comte, and on "some new grasses found by Dr. James, on the rocky mountains," by Dr. Torrey.

Mr. Schweinitz, whom we have already more than once alluded to, is a native of Germany, where, as well as throughout Europe, he is advantageously known, in conjunction with M. Albertini, as the author of a Latin work on the *Fungi of Upper Lusatia*. Since his residence in America, he has continued to dedicate most of his attention to the fungi; and his manuscript, containing an account of 1373 fungi found in Upper Carolina alone, was edited by Dr. Schwaegrichen in 1823, under the title of "*Synopsis Fungorum Carolinæ Superioris*," in a thin volume, 4to; and it is not a little singular to observe how many of these are common to Europe as well as America.

We shall close our notice of American botanical publications by the mention of that, which if we may judge from the first number (which is all that we have yet received from the author,) bids fair to rank among the most valuable that has appeared in that country; the *Flora of the Middle and Northern Sections of the United States, by Dr. Torrey.* A frequent correspondence, and a mutual interchange of botanical specimens, have made us acquainted with the zeal and acquirements of this gentleman; both of which are now assiduously engaged in the preparation of his work, the continuation of which we anxiously expect. No. I. extends as far as, but not to the conclusion of, the *Class Triandria*, and *Order Digynia;* for here likewise the arrangement is that of Linnæus. The whole is in English. The synonyms are sufficiently copious, and the descriptive part contains much useful criticism and observation. We know, too, that Dr. Torrey has made a most ample collection of the cryptogamic plants of the United States; that he is well acquainted with the species and their characters; and we may therefore confidently hope that this department of botany will now find a place in the Floras of North America.

Our attention has hitherto been almost exclusively turned to the progress of botany in the United States. There is still a vast extent of highly interesting country to the northward, from the 45th parallel of lat. to 74, including 29 degrees, and to the westward, which, as being for the most part either in the acknowledged possession of the British government, or of the Hudson's Bay Company, or what has been explored by British enterprise, we shall denominate the *British possessions in North America.*

Small, indeed, compared to the extent of the country, is the amount of what has been published *exclusively* on the plants of these regions. We may, we believe, sum up the whole in the mention of the Botanical Appendix to Captain Franklin's Narrative, and those to the various recent Arctic Voyages of Discovery, among which the observations of our countryman, Brown, have given an additional interest to the subject, besides a small paper upon some new and rare Canadian plants, gathered by Mr. Goldie during an excursion of some extent in that country, which was printed in the *Edinburgh Philosophical Journal.* Unless we indeed extend our remarks to Greenland, of which country a list of the plants has been printed by Sir Charles Giesecké, in the *Edinburgh Encyclopædia*, art. GREENLAND, and other species are included in the *Flora Danica* of Professor Hornemann.

Brief and scanty as is this catalogue, we anticipate, from the mostly unpublished collections that have been formed, and from the various expeditions that are now sent out, or that are about to be so, that, in a very few years Great Britain will be in a condition to fill up the void which exists in her Flora of her portion of North America.

The herbaria at present existing, as connected with the plants of those countries, over and above those to which we have already alluded, are perhaps not very extensive. Sir Joseph Banks made collections on the Labrador coast, and we believe that the missionaries of that territory have sent home many plants to the Museum of their Society. Lady Hamilton possesses numerous well-dried plants of Newfoundland, and we have ourselves opened a correspondence with some gentlemen of that island, from whom much may be expected. In Canada, besides what has been effected by Mr. Pursh, we know of several individuals who are industriously engaged in furthering the Flora of that country, and of Hudson's Bay. In the first rank of these, we are proud to be able to mention the Right Honourable the Countess of Dalhousie, the lady of his Excellency the Governor, whose rank and influence, no less than her superior acquirements and great love of science, entitle us to hope for much from her in the promotion of our wishes. On the sea coast of Hudson's Bay, collections made as far north as Chesterfield Inlet, during Duncan's voyage of discovery, exist, we believe, in the Banksian Herbarium. Mr. Graham in Foster's time, sent plants as well as animals home from Churchill. Tilden's plants, in the Sherardian Herbarium, are from Moose-factory, near the bottom of Hudson's Bay. In the interior, to the eastward of the rocky mountains, no one has botanized but Dr. Richardson, during Franklin's journey. With the fate of a large portion of that collection, and with the affecting and afflicting cause of it, the public are well acquainted. On the north-west coast, Mr. Menzies* has been the principal investigator; but a Mr. Nelson, who perhaps accompanied some of the voyagers, who succeeded Captain Cook in the survey of that coast, has communicated many specimens, which are in the Banksian or Lambertian Herbarium. Pallas' Herbarium, in the hands of Mr. Lambert, contains plants gathered by the Russians in the Aleutian isles, and De Candolle has published, in his Prodromus, some interesting individuals, communicated by Dr. Fischer from the same neighbourhood.

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* Many of these plants have been ably described by our valued friend Sir J. E. Smith, President of the Linnæan Society, in the botanical part of Rees's Cyclopædia.

More ample materials may confidently be looked for from the following sources:—The great attention already bestowed during former voyages by Captain Parry and his officers, to the vegetable productions of the Arctic regions, would alone warrant us in expecting that the same desire will be felt during the present expedition, to contribute all in their power to the natural history of the countries which they explore. But we have farther the assurance of the distinguished commander of the expedition himself, in the last letter which we received from him, dated Whale Fish Islands, July 1, that no exertion should be wanting on his part to secure every species of plant that may be met with in the course of the voyage.

The Horticultural Society of London have despatched one of their most able collectors to the mouth of the Columbia, David Douglas, who was formerly one of the head gardeners at the Glasgow botanical garden. He had, immediately previous to his being sent on the present expedition, done himself great credit, and given his employers the highest satisfaction, during his mission to the United States, for the purpose of procuring plants and fruits for the society. His undertaking is now a far more arduous one, and one in which we know that no exertions on his part will be wanted to bring it to a successful issue. After spending the ensuing season in collecting on the north-west coast, through nearly ten degrees of latitude, he will cross the Rocky Mountains in lat. 55°, and fall in with Captain Franklin's line of route at Isle de la Crosse, and return overland with that enterprising officer to Hudson's Bay.

The Hudson's Bay Company, with a liberality that reflects the highest credit upon them, made application and provision for a surgeon to one of their ships, who, to his medical knowledge should have added the acquirement of natural history, particularly of botany. It was our good fortune to have in view, at the period when the application was made to us, a young man every way qualified for such a situation, Mr. Scouler, unquestionably one of our ablest botanical students. He embarked for the north-west coast of America in the month of July of this year (1824,) and will be absent altogether two years.

The greater portion of the interior of this extended country, and its northern coast, remains to be explored and investigated by Captain Franklin and our inestimable friend Dr. Richardson, together with the officers and men who will be appointed to accompany them. Of the botanical acquirements of the last-named gentleman we have the highest opinion. For zeal in collecting he cannot be surpassed; still, in order that his collections may be more complete, and that a greater extent of country may be embraced, he has, partly at his own expense, and partly by the aid of government, resolved upon taking with him Mr. Drummond of Forfar, whom we have already mentioned in this Journal most favourably, as the author of a valuable work on the mosses of Scotland, and whom we have no hesitation in pronouncing to be one of the most acute and ardent followers of botany that this country possesses.

The expedition, as is well known, will embark early in February, and it will land at New York. Captain Franklin, Dr. Richardson, and Mr. Drummond will proceed together as far as Red River on Lake Winipeg, or Carlton House on the Saskatchawan, which will be Drummond's head quarters for two summers, from whence he will make excursions in company with the fur traders, at the head of that vast valley which forms the extensive plain across the Missouri, and opens towards Mexico. Here, therefore, he may be expected to meet with a highly curious vegetation and plants, similar to those which Nuttall, James, and Bradbury discovered on the banks of the Missouri itself. He will likewise have the opportunity of botanizing on the declivities of the Rocky Mountains, in lat. 52°.

Captain Franklin and Dr. Richardson will proceed together as far as the mouth of the Mackenzie River, which will probably be the extreme northern point attained by the latter;

for his great object is to examine, with the utmost care, the region which lies between Mackenzie and Coppermine rivers; and here he will unquestionably more than supply the place of those collections which were lost during the former journey. Captain Franklin again, and the officer that accompanies him, will proceed from the mouth of the Mackenzie in boats, to Behring's Straits; they will doubtless devote as much time as their other important avocations will permit, in gathering plants and other objects of natural history; and Dr. Richardson will take care to instruct one or more of the party in the mode of preserving vegetable productions. The prayers and the wishes of their friends, and of every friend to science, will accompany these able and intrepid investigators.

Some idea may now be formed of the extent and value of the collections which will be obtained, and we are confident that such arrangements will be made as will secure to every botanist the credit of his respective discoveries. We think then, that these should be destined for the foundation of a *Flora of the British Possessions in North America;* which, if no individual more competent to the task presents himself, the writer of the present article will not shrink from undertaking; and this he offers to do the more readily, since some of the most effectual aid has already, and unsolicited, been offered to him.

ART. XXI.—*On the Production of Crystallized Minerals by heat.* By Mr. E. MITSCHERLICH, Professor of Chemistry in the University of Berlin.

AT Fahlun and Garpenberg in Sweden, and in several of the founderies of Germany, I had observed that the scoriae possessed the same form, and were composed of the same elements as certain minerals found in nature; and I possess at present upwards of forty different species. Among these are the subsilicate of the protoxide of iron, the silicate of the protoxide of iron, also that of the protoxide of iron and of lime, and that of magnesia and lime. These substances, when crystallized, present the form of peridot. Another class of them are the bisilicates of protoxide of iron, of protoxide of iron and lime, of lime and magnesia, which are formed among the slags of iron furnaces; these possess the same primitive and secondary forms as pyroxene. I possess also the trisilicate of lime, the protoxide of copper, the oxide of zinc, the deutoxide of copper, the magnetic iron-ore (*oxidum ferroso-ferricum*,) the sulphurets of iron, zinc, and lead; the arseniuret of nickel, &c.

1. *Having the form of Peridot.*—The silicate of iron is an important compound in the processes of melting copper and iron. I found two varieties, 1. from the melting of copper, and 2. from the refining process of cast-iron, composed of

Silica, . .	30.93	31.06
Protoxide of iron,	69.07	67.34
Magnesia, . .	0.00	00.65
	100.00	99.05

Another variety formed in a high furnace, yielded to me as much as 12 p. cent. carbonate of lime; the oxygen of the silica, however, was the same as that of lime and protoxide of iron taken together. All these crystals have exactly the same form as peridot, whose primitive form is a right rectangular prism, and which, therefore, is the form of those silicates, whose bases have two atoms of oxygen. The common varieties resemble Fig. 33. of Plate III; and Fig. 34. is the projection upon the plane of P, of all those secondary faces which I have observed in any of those slags, in Peridot, and in Hyalosiderite together. The latter has been described by M. Walchner; it is a Peridot, which contains more iron than the common varieties.

2. *Having the form of Pyroxene.*—When I came to Paris, M. Berthier had the kindness to communicate to me the results of a vast number of researches, which he had instituted on the fusibility of the silicates. Some of these silicates had crystallized and assumed the crystalline forms, the same angles, and the same essential external characters as those minerals which possess a similar mixture. Thus M. Berthier has fused silica, magnesia, and lime, in a carbon crucible in the necessary proportions to form a bisilicate, in which the

oxygen of the lime was equal to the oxygen of the magnesia; and in another experiment, he melted the same elements in such a proportion, that the oxygen of the magnesia was double the oxygen of the lime. The results of both were pyroxenes, the counterparts of which we find in nature; the first is the ordinary pyroxene, the other is one of those from Finland, analysed by Mr. Nordenskiöld. The crystals of silicate of manganese, which I had never seen before, obtained by M. Berthier in fusing carbonate of manganese with silica, are particularly remarkable; they are very well pronounced, and possess exactly the form of the silicate of iron described above, and of peridot.

3. *Having the appearance of Mica.*—There are some varieties among the old scoriae, found in the vicinity of Garpenberg castle in Sweden, which present absolutely the same characters as mica. They produce an uniform mass, consisting of lamellæ of two or three lines diameter, semitransparent and splendent. In the drusy cavities there are transparent six-sided tabular crystals. In regard to its composition, which I ascertained by analysis, it resembles the black Siberian mica analysed by Klaproth.

	Mica from Garpenberg.	Mica from Siberia.
Silica, . . .	47.31	42.00
Alumina, . .	5.74	11.05
Peroxide of Iron, .	28.91	22.00
Peroxide of Manganese,	0.48	2.00
Lime, . . .	0.23	0.00
Magnesia, . .	10.17	9.00
Potash, . .	1.05	10.00

Inferences from the preceding observations in regard to Geology.—The artificial production of minerals by fusion puts beyond the slightest doubt, the idea of our primitive mountains having been originally in a state of igneous fusion. This state gives a satisfactory explanation of the form of the earth, of the increase of temperature at greater depths, of hot springs, and many other phenomena. At that time, during this high degree of temperature, the water of the sea must have formed an elastic fluid round the globe, according to the experiments of M. Cagnard de la Tour.

The primitive mountains are distinguished from the volcanic productions, chiefly in their containing lime and magnesia in the state of carbonates, while they form silicates and bisilicates with the silica in volcanic rocks. It is conceivable, that the silica, which in a higher degree of temperature at the ordinary pressure of the atmosphere, drives away the carbonic acid, is on the other hand expelled by the carbonic acid under the influence of a high pressure. It is not therefore surprising to find quartz crystals in Carrara marble. But, as at the period of the formation of volcanic rocks, this high pressure, produced by the evaporation of the water of the sea, did not take place any longer, we find in them the same combinations which we obtain in our laboratories, and in metallurgical processes.

It is proved by many observations, that the level of the sea must have been, at some ancient period, higher than it is at present. This can be easily accounted for, if we consider that water heated must be more expanded than the solid earth. If we suppose with M. de la Place, that the average depth of the sea is 96,000 feet, and assume the dilatation of the earth to be equal to that of glass, we find, that at a temperature of 100° centigr., the sea would be 4000 feet higher than it is at present, and that it would cover most of the secondary mountains. The melted masses shrink during their cooling. If this happens in large masses, cavities, garnished with crystals, must result, geodes, &c.

Inferences drawn in regard to metallurgical processes.—The process of the melting of copper ore at Fahlun may be explained as follows, viz. The ore consists of copper-pyrites, and iron-pyrites, of two varieties; one of them is rich, and the other very much mixed with quartz. They are first roasted, and thereby converted into a mixture of sulphuret, oxide, and sulphate. The roasted mineral is now melted in the proportion of three parts of the rich ore to one part of the quartzy variety. But the melters must be always attentive to the furnace, and add now part of the one, now part of the other of the two kinds of ore, so as always to have the slags, consisting of a bisilicate of protoxide of iron. This slag is lamellar, and crystallizes like pyroxene. At the same time metallic compounds are obtained, consisting of sulphuret of iron, and sulphuret of copper. If the ore has been too much roasted, there remains too little sulphuret of iron to collect all the cupreous particles throughout the whole mass of the slags; and the smelters must add in this case some of the rich ore not roasted.

The metallic compounds are roasted six times; and, by this operation they are transformed into a mixture of magnetic oxide of iron, and oxide of copper. This mass is now melted either with quartz, or with the quartzy ore, and their result is a silicate of the protoxide of iron and black copper. In the process followed in the Hartz for refining copper, much protoxide of that metal is formed, in the middle of which large crystals of arsenious acid are found, but never, as far as I know, any oxide of antimony.

The purpose of refining iron is to separate along with the carbon, all those substances which might have a bad influence on the quality of the wrought iron. In this view part of the pig-iron is first oxydised; the oxide of iron combines with the silica, which either is introduced by the charcoal, or produced by the decomposition of the silica contained in the iron, and forms a silicate. If the quantity of oxide of iron is too great, this oxide again acts upon the melted iron, or it combines with the silicate, and forms a sub-silicate, which being very fusible, will mix entirely with the melted mass, and burn its carbon, because the affinity between the oxide and silica is greater for forming a silicate than an embrolicate, and to discharge the rest of the oxide, when in contact with the carbon at the temperature of the refining furnaces.—(*Ann. de Chim.* tom xxiv. p. 355; *Ann. des Mines*, tom ix. p. 176.)

ART. XXII.—*Notice respecting Euchroite, a New Mineral Species.* By WILLIAM HAIDINGER, Esq. F.R.S.E. Communicated by the Author.

A MINERAL has lately been brought to this country under the name of *Euchroite*, of which a short notice will find here its proper place, as it does not seem to have yet been described even in the foreign journals.

Form, prismatic. $P = 119° 7', 81° 47', 120° 54'$. ($a : b : c = 1 : \surd 0.928 : \surd 0.344$). Approximation.

Simple forms. $P - \infty$ (P); $P + \infty$ (M) $= 117° 20'$; $(\breve{P}r + \infty)^5$ (s) $= 95° 12'$; $(\breve{P}r + \infty)^3$ (i) $= 78° 47'$; $\breve{P}r$ (n) $= 87° 52'$; $\breve{P}r + \infty$ (k.)

Combinations, 1 . $P - \infty . \breve{P}r . P + \infty . (\breve{P}r + \infty)^3$. Plate III. Fig. 29. 2 . $P - \infty . \breve{P}r . P + \infty . (\breve{P}r + \infty)^3 . (\breve{P}r + \infty)^5 . \breve{P}r + \infty$. Fig. 30.

Cleavage, indistinct, parallel to the horizontal prism *n*, and to the vertical prism *m*, very much interrupted. Fracture, small conchoidal, uneven. Surface, the vertical prisms striated parallel to their common edges of intersection, the horizontal prism smooth, $P - \infty$ often rounded, as if a drop of the solution had remained after the complete formation of the crystal.

Lustre, vitreous. Colour, bright emerald-green. Streak, pale apple-green. Double refraction, considerable. Semi-transparent, translucent.

Rather brittle. Hardness = 3.5 . . . 4.0 (very near the same as fluor). Sp. gr. = 3.389. As the specimen employed was not entirely free from the oxide of iron, it is possible that the specific gravity is a little higher, though this can be but very inconsiderable.

Observations.

1. The specimen of Euchroite to which the preceding description refers, was purchased last summer by Mr. Allan when in London, from Mr. Sowerby, who had received the mineral from Mr. Bartsch of Vienna. It has been found at Libethen in Hungary, and occurs in crystals of considerable size, in fissures in the common quartzoze mica slate of that locality. Some of the crystals in Mr. Allan's specimen are upwards of three lines in every dimension, though the most perfect crystals are much smaller. They are in no small degree like those of Dioptase, and will enter the genus Emerald-malachite of Mohs.

2. Euchroite contains a considerable proportion of water and copper. An exact indication of the rest of the ingredients in its remarkable chemical composition, will be given in the next number of this Journal, Dr. Turner having, at my request, kindly undertaken an examination of it.

ART. XXIII.—CONTRIBUTIONS TO POPULAR SCIENCE.

No. III. On the Structure of Rice Paper. *

THE substance commonly known by the name of *Rice Paper* is brought from China in small pieces, about two inches square, and tinged with various colours. It has been for some time used as an excellent substitute for drawing paper, in the representation of richly coloured insects, and other objects of natural history, and has been employed in this city with still more success in the manufacture of artificial flowers.

Although rice paper has a general resemblance to a substance formed by art, yet a very slight examination of it with the miscroscope is sufficient to indicate a vegetable organization. In order to observe and trace the nature of its structure, it was necessary to give it some degree of transparency; and I expected to accomplish this by the usual process of immersing it in *water* or in *oil* of the same refractive power. This operation, however, instead of increasing the transparency rendered the film more opaque, and suggested the probability that, like Tabasheer, it was filled with air; and that the augmentation of its opacity arose, as in the case of that silicious concretion, from the partial absorption of the fluid.

In order to expel the air from the cells in which it seemed to be lodged, I exposed a piece of the rice paper to the influence of boiling olive oil. The heat immediately drove the air in small bubbles from the cells near the margin; but it was with some difficulty that it was forced to quit the interior parts of the film. As the olive oil had now taken the place of the air, and filled all the cells, the film beame perfectly transparent, and displayed its vesicular structure when placed under a powerful microscope.

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* From an unpublished MS. by Dr. Brewster, read before the Royal Society of Edinburgh, on the 4th March, 1822.

It will appear from the drawing executed by Mr. Greville, Plate II. Fig. 11, that the rice paper consists of long hexagonal cells, whose length is parallel to the surface of the film; that these cells are *filled with air*, when the film is in its usual state; and that from this circumstance it derives that peculiar softness which renders it so well adapted for the purposes to which it is applied. When the film is exposed to polarised light, the longitudinal septa of the cells depolarise the light like other vegetable membranes.

Among the three specimens of rice paper which I have produced, there is *one* from which all the air has been expelled by the boiling oil; *another* in which some of the air bubbles still appear in the vesicles, the air having been only partially expelled by boiling water; and a *third*, which is in contact with water, without having been deprived of any of its air bubbles.

Upon mentioning to Mr. Neill the preceding experiments, he informed me that the lady in Edinburgh, Miss Jack, who had employed rice paper with such success in the manufacture of artificial flowers, had learned from her brother, who was in China, that it was a membrane of the bread fruit tree, the *artocarpus incisifolia* of naturalists.

No. IV. On the Convergency of the Solar Beams to a point opposite to the Sun.

THE divergency of the solar beams, when the sun is descending in the west, is a phenomenon which occurs so frequently, that the most careless observer must have had occasion to notice it. This phenomenon, however, is sometimes accompanied with one of an opposite kind, viz. the *convergency of the solar beams to a point opposite to the sun, and as far below the horizon as the sun is above it.* This phenomenon is extremely rare; and we are not aware that it has been described more than once, viz. by Dr. Robert Smith of Cambridge who observes, that he *once* saw it upon Lincolnheath.* He describes it as "an apparent convergence, of long whitish beams, towards a point diametrically opposite to the sun. For as near as I could estimate, it was situated as much below the horizon as the sun was then elevated above the opposite point of it." "In the unusual phenomenon," Dr. Smith afterwards adds, "I well remember, that the converging sun-beams towards the point below the horizon, were not quite so bright and shining as those usually are which diverge from him, and that the sky beyond them appeared very black, which certainly contributed to the evidence of this appearance." Smith's *Optics*, vol. ii. Remarks, p. 57, 58.

On Saturday, the 9th October, 1824, Dr. Brewster had the pleasure to observe this curious phenomenon when travelling from Melrose to Edinburgh, and of pointing it out to two friends who accompanied him. It was first seen at that part of the road opposite to the avenue to Kirkhill, the seat of John Tod, Esq. at about a quarter past four o'clock. The sun was then considerably elevated above the Pentland range of hills, and was throwing out his diverging beams in great beauty through the interstices of the broken masses of clouds which floated in the west. The eastern part of the horizon, where the converging lines were seen, was occupied with a dark black cloud, as described by Dr. Smith, and which seems necessary as a ground for rendering visible such faint radiations. The converging beams were very much fainter than the diverging ones, and the point to which they converged was as near as could be estimated, as far below the horizon as the sun was above it. About ten minutes after the phenomenon was first seen, the convergent lines *were black* or very dark. This arose from the real beams having become broad, and of irregular intensity, so that the eye took up, as it were, the spaces between the beams more readily than the beams themselves.

In order to explain the cause of this phenomenon minutely, several diagrams would be necessary, for which we cannot at present find room; but we think it may be perhaps more easily understood from the following illustration.

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* A similar phenomenon has, we understand, been observed near Freiberg, by Professor Mohs and Mr. Haidinger. There were clouds in the west between the observers and the sun.

Let us suppose a line to join the eye of the observer and the sun; let rays issue from the sun in all possible directions, and let us suppose that planes pass through these radiations, *and through the line joining the observer and the sun*, which will be their common intersection, like the axis of an orange, or the axis of the earth, through which there passes all the septa of the former and all the planes passing through the meridians of the latter. An eye, therefore, situated in that line or common intersection of all the planes, will see them diverging from the sun on one side, and converging towards the opposite point, just as an eye in the axis of a globe would perceive all the planes passing through the meridians, diverging on one side and converging on another.

Art. XXIV.—*History of the Great Mass of Native Malleable Iron of Louisiana, now deposited in the Museum of the New York Historical Society.*

Just as the last sheets of this Journal were about to be put to press, we have been favoured, through the kindness of Mr. Allan, with the last number of Professor Silliman's Journal, which has arrived by a shorter channel than our own copy, and which contains two articles of such deep scientific interest, that we have been obliged to delay several other articles in order to find room for them. The first of these relates to the malleable iron of Louisiana, and has been drawn up from various original documents communicated to Professor Silliman.

"In 1808, while Captain Glass was trading among the Pawnee and Hietan nations, he heard of a curious mineral, and saw the Pawnee Indian who discovered it on the territory of the Hietans. Captain Glass and several of his party accompanied some Indians, and saw the mass *in situ*. The Indians regarded it with much veneration, and ascribed to it singular power in the cure of diseases. They informed him that they knew of two other smaller pieces, the one about thirty, and the other about fifty miles distant.

This intelligence having excited much curiosity, two rival parties were formed in 1810 for obtaining this metal, one at Natchitoches, consisting of George Schamp, who had been with Captain Glass, and nine associates; the other at Nacodoches, consisting of John Davis, who also had been with Captain Glass, and eight or ten associates.

The Nacodoches party first arrived at the place of destination; but having, in their hurry to anticipate the rival party, made no preparations for carrying away the metal, they laid it under a flat stone, and went away for wheels and draft horses.

The Natchitoches party arrived a few days afterwards; and after searching several days, succeeded in finding their object. Being provided with tools, they made a truck waggon, to which they harnessed six horses, and set off with their prize towards the Red River. They crossed the Brassos without much difficulty; but a straggling party of Indians having one night stolen all their horses, they were detained until two of their party could go to Natchitoches for more horses. On arriving at the Red River, some of their party went down in a boat with the iron, while others took the horses down by land. From Natchitoches the metal was taken down the Red River and Mississippi to New Orleans, from whence it was shipped to New York.

In February 1812, John Maley, an erratic adventurer, went with a few associates up the Red River, to explore the country, to trade with the Indians, and to bring away the two remaining masses of metal. He saw one or both of the masses; but being unable to make the remuneration for them demanded by the Indians, he continued his tour farther west. Returning, he continued to barter for the pieces of metal, a certain quantity of merchandise, to procure which, he returned to Natchitoches, and proceeded to New Orleans.

On his second expedition up the Red River in 1813, he and his associates being robbed by a party of the Osages of the merchandise and horses, were compelled to return on foot, relinquishing their object."—*Maley's MS. Journal.*

As at least two masses, therefore, of this metal undoubtedly exist in this quarter, it becomes very interesting to determine their probable locality, and any other circumstances connected with them. These masses are said to be fifty or sixty miles south-west of Pawnee village, on the banks of the Red River, some hundred miles above Natchitoches. Captain Glass makes the locality of the metal some days journey to the south of the Pawnee village, on the River Brassos. Dr. Sibley, who had conversed with Captain Glass, and others of the parties who went in quest of the metal, states the distance from Natchitoches to the Pawnee village as nearly 400 miles by land, and the distance by water from the place of embarkment to Natchitoches as nearly 1000 miles. The account then proceeds:—

"John Maley travelled in these regions subsequently to the removal of the large mass, but visited one or more smaller masses. "Crossing the river," he says, "at the Pawnee village, we took a S.W. course over large ledges of limestone and extensive prairies. After a journey of three days, we were conducted by the Indians to this metal. It lay a few miles from the mountain, which appeared to be the same that I have before described as running parallel to the Red River." He does not state whether he saw one piece or more; but he afterwards stipulated for the *two pieces of metal*. The Pawnee village, he says, is 1500 miles above the confluence of the Red River with the Mississippi.

Judge Johnson being in company with Mr. Maley some years since, entered into conversation on this subject. He was informed by Maley, that the pieces were found in the midst of an open sterile plain, *lying over each other, and appearing as if broken and scattered in the fall of one entire mass.* "The place was described by Maley as about 200 (400?) miles in breadth, north and west from Natchitoches, in (near?) the ridge between the waters of the Red River and the Rio Bravo."

Mr. Bringier has mentioned, (Silliman's *Journal*, vol. iii. p. 15.) apparently from personal observation, that the locality of the metal is in West Long. 95° 10′, and North Lat. 32° 7′. Mr. William Darby places it twenty degrees west of Washington city, or in long. 97°, and in lat. 32° 20′. As this mass of iron contains nickel, like the other masses found in the other parts of the globe, there can be no doubt that it is of meteoric origin, and, consequently, every particular connected with its history possesses the deepest interest.

ART. XXV.—*On the Existence of Silicious Solutions in the Drusy Cavities of Minerals.*

THE same Number of Professor Silliman's *Journal* from which we have abridged the preceding interesting article contains another of not less importance to science. It is entitled, *Facts tending to illustrate the Formation of Crystals in Geodes*; and we have no doubt that the two great and new facts which it contains will for ever put to rest this long-agitated question.

In the few paragraphs and speculations which this paper contains, the author mentions more than once the new fluids discovered in minerals by Dr. Brewster; but from some strange mistake, he calls them *microscopic fluids*, and *as discernible only by the aid of powerful microscopes.* If the author had read with care the account of these fluids, he would have found that some of the cavities (the one in Mr. Allan's fine specimen, for example) are nearly the *fifth* of an inch long, and that the fluids have been taken out of the cavities, looked at with the naked eye, and touched, tasted, and subjected to chemical experiments. Having corrected this misapprehension, arising no doubt from the author's quoting from memory, we proceed to the facts themselves.

"When Mr. B. F. Northrop, of Yale College, was breaking some ballast stones, from New Orleans, consisting of hornstone, flint, chalcedony, and quartz pebbles, he found many of them with cavities lined with crystals of hyaline quartz. Some of the cavities were lined with mammillary chalcedony, and others with a white spongy deposite resembling an earthy precipitate. Upon breaking an oval pebble of hornstone, whose diameter was three inches by two, Mr. Northrop found in its centre a cavity of three-fourths of an inch by half an inch, filled with a milky fluid, like water containing magnesia.

He unfortunately spilled the greater part of the fluid, and before the remainder could be secured, it was exhaled (it being a very hot day) by a rapid evaporation, leaving a white spongy precipitate lining the cavity, and staining the surfaces of fracture. *During this rapid evaporation minute prismatic crystals shot from the fluid,* even under the eye of the observer, occupying not only parts of the cavity, but also of the surfaces of the fracture. Both the crystals and the spongy mass were easily ascertained to be *silex.* They neither effervesced nor dissolved in acids, and when rubbed between surfaces of glass, they took hold of it with great eagerness, instantly depriving it of its polish, and scratching it as distinctly as a file does iron.

This was true, not only of the spongy matter, but of the separate crystals, which we are entitled to consider as crystals of quartz, almost instantaneously deposited, from a rich silicious solution. These crystals were of a rather dull white, without much lustre or transparency. Their diameter was that of fine sewing silk, and their length not exceeding one-sixth of an inch. It is much to be regretted, that no opportunity was afforded of examining the fluid, so that it is impossible to say whether it was some modification of water, or a distinct fluid. The earthy deposite, and the crystals were tasteless, and proved to be a very sharp grit between the teeth.

In the centre of another pebble, five inches by three, and consisting of a mixture of hornstone and chalcedony, Mr. Northrop found another cavity of one and a half by one inch, nearly filled with the spongy silicious deposite already described, *but it was still moist,* to such a degree, as to form a pulpy or gelatinous mass, very soft and impressible; this mass was also soon dried by the intense heat of the weather. As there was less fluid to evaporate, so, as might have been expected, there were but few crystals formed; still, *they shot, here and there,* as in the other cavity. The spongy mass in the cavity of the larger stone admits a knife to penetrate it more than an inch, and portions of its surface have a mamillary and stalactitical appearance. It is silex, like the other. In many other pebbles cavities have been observed, some lined with the spongy silicious deposites, intermixed with minute prismatic crystals, which have, however, *rather more lustre* than those which were so rapidly formed; and the stone forming most of the immediate walls of the interior of the cavities is of an opaque enamel, white as if it had been penetrated by a fluid, and in some measure softened by incipient solution. In a few cavities, the silicious matter had concreted into well-characterized mamillary chalcedony."

The next fact mentioned by Professor Silliman is not less interesting than the preceding, and was communicated to him by Mr. Eli Whitney of Newhaven, who saw the specimens alluded to in Georgia in 1806.

"In clearing a mill-dam, built on a solid mass of agate, (a silicious stone, consisting of a mixture of jasper, hornstone, quartz, and chalcedony,) the workmen discovered a great number of hollow balls in their form resembling bomb-shells. Some of them were as large as a man's head, and some even eight or nine inches in diameter. When broken they proved to be mere shells, the walls of which were from five-eights to three-fourths of an inch in diameter, and the capacity of the cavity was from a pint to two quarts or more. *This cavity was filled with a milky fluid, so nearly resembling white paint or white wash,* that it was used to whiten the fire places and the walls of the rooms of the neighbouring houses.

The next fact quoted by our author is from Bournon's *Mineralogy*, vol. ii. p. 33, and which relates to a cavity containing water, and which, after the evaporation of the water, contained a spongy, crystalline, amorphous mass of carbonate of lime. The learned editor has omitted to cite a still more remarkable case of a *group of regular crystals of carbonate of lime,* discovered by Dr. Brewster in a cavity of a quartz crystal from Quebec, in the cabinet of Mr. Allan, one of the most curious specimens of the kind that has perhaps ever been seen. This specimen is fully described in the *Edinburgh Transactions*, vol. x. p. 29.

Art. XXVI.—DECISIONS ON DISPUTED INVENTIONS AND DISCOVERIES.

There are few subjects which come under the notice of the historian of science, which excite so lively an interest as the discussion of conflicting claims to valuable inventions and discoveries. Although the rights which are thus brought under review are always those of Individuals, yet Nations have often descended into the arena, and, on some occasions, even the New World has arrayed itself against the Old, upon a question of scientific history.

In the progress of human knowledge, the most valuable inventions and discoveries are often completed by different individuals, and at distant intervals. To one we may owe the germ of an original thought; another may be employed in bringing it towards maturity, while the genius of a third may be requisite to carry it to the perfection of which it is susceptible. In such cases, which resemble that of the Steam Engine, it is extremely difficult to apportion to each author his due share of merit; and it is perhaps unnecessary, as long as history continues, to record the exertions and labours of each competitor.

In other cases, however, the difficulty of adjudication is not so great. An invention has often been excluded from the history of science, when its importance has been derived from subsequent discoveries, or when it has been recorded in a work which is either too profound to be generally read, or too rare to be generally accessible. When such inventions have been brought forward as new, we must be careful of accusing of plagiarism the philosopher who announces them. Men who are engaged in similar inquiries are often led to the same views, and even to the same inventions; and no calumny can be more injurious than that of charging such a person with the most odious of literary crimes, when he is perhaps entitled to the full honour of a second inventor.

There are circumstances, however, under which a charge of plagiarism may be preferred. When a second inventor embraces the earliest opportunity of stating that he has been anticipated, when he openly and fairly discusses the claim of his predecessor to the invention;—then if he has been in the habit of doing justice to others, of acknowledging their merit, and of praising the inventions of his rivals when praise is due, posterity will have no difficulty in assigning to him all the merits of a *second inventor*, and in adding to that the higher attribute of an honest and liberal mind. But if, on the contrary, he strives to conceal or put down the claim of the first inventor,—if he omits every opportunity of acknowledging the anticipation,—if, to this obstinacy, he adds the general character of grudging every man his share of fame,—if, as an author, he declines to record the labours and discoveries of those whom he places in the list of his enemies or his rivals,—and if, as a teacher, he refuses to explain to the youth under his charge the inventions and discoveries of his contemporaries,—if, to these unequivocal symptoms, he adds another, viz. that of exaggerating and praising his own inventions, and of obtruding them in all his writings,—then, the character of such a man is drawn by his own hand; and if public decency prevents his contemporaries from adding the title of plagiarist to his Christian name, posterity will not fail to write upon his monument, "Here lies a man whose love of reputation was so inordinate, and his love of justice so small, that he appropriated to himself the inventions and discoveries both of the dead and the living; and when he had carried off all that his shoulders could bear, returned to spike and to destroy all that he had left behind." *

Such are the principles of scientific law, which we shall apply to the illustration of those contested questions, that we shall from time to time submit to the decision of public opinion. Our design is to be just and merciful. If at any time we forget these attributes, that public opinion which we invoke on others will not fail to fall heavily on ourselves.

The task of deciding such causes as these, though a difficult one, is not of an ungenerous character. What we take from one we liberally confer upon another; and when the contest is with a living candidate, we may perhaps lay claim to some share of right feeling, even if we are too generous to those who are long since gone, and whose rights and labours are not under the protection of country, kindred, or friendship,—or any of those strong holds of local feeling, in which the claims of living genius are so deeply intrenched.

1. *Professor Leslie's Differential Thermometer invented by Professor Sturmius.*

More than twenty years ago, Professor Leslie announced to the world his invention of a differential thermometer, for measuring small differences of temperature; and he made it the basis of a series of instruments which bear his own name, and which have been manufactured and sold by himself.

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* In these views we are supported by the high authority of Professor Playfair. Speaking of Descartes' alleged Plagiarism of the Law of Refraction, discovered by Snellius, he says, "There is no doubt, therefore, that the discovery was first made by Snellius; but whether Descartes derived it from him, or was himself the *second discoverer*, remains undecided. The question is one of those where a man's conduct in *a particular situation* can only be rightly interpreted from his *general character and behaviour.* If Descartes had been uniformly fair and candid in his intercourse with others, one would have rejected with disdain a suspicion of the kind just mentioned. But the truth is, that he appears throughout a jealous and imperious man, *always inclined to depress and conceal the merit of others.* In speaking of the invention of the telescope, he has told minutely all that is due to accident, but has passed carefully over all that proceeded from design; and has incurred the reproach of relating the origin of the instrument *without mentioning the name of Galileo.* In the same manner he *omits to speak* of the discoveries of Kepler as nearly connected with his own; and in treating of the Rainbow, he *has made no mention* of Antonio de Dominis. It is impossible that this should not produce an unfavourable impression; and hence it is that the warmest admirers of Descartes do not pretend that his conduct towards Snellius can be completely justified."—*Supp. Ency. Britt.* Vol. II. p. 101.

About the same time, or perhaps earlier,* Count Rumford announced the construction of an instrument, called a *Thermoscope*, which he used in the same manner, and for the same purposes, and which, he says, "*he contrived* for measuring, or rather for discovering, very small changes of temperature." Count Rumford was loudly charged, not only with having stolen Mr. Leslie's invention, but even with having abstracted, or caused to be abstracted, certain sheets of Mr. Leslie's work on Heat from Gillet's printing office.

It is needless to inform our readers that Count Rumford's thermoscope, and Mr. Leslie's differential thermometer are identically the same, and that they both consist of a glass tube, bent in the shape of the letter U, and having at each end a glass ball filled with air, while the legs and horizontal branch contain a coloured fluid.

We do not mean at present to decide the question between Count Rumford and Professor Leslie, though the details which it involves furnish much curious matter of scientific history.

Sir Humphry Davy, in his *Elements of Chemical Philosophy*, published in 1803, (pages 75, 76, and Plate I. Figs. 2, 3.) was the first to rectify the history of the differential thermometer. This distinguished chemist ascribes it to Van Helmont, who died in 1644, and he placed on the same plate engravings of the instrument of Van Helmont, and of that of Mr. Leslie. No sooner did this work of Sir Humphry's appear, than it was attacked in a letter in the *newspapers*, bearing, we believe, Mr. Leslie's name, which was ably answered by some friend of Sir Humphry Davy's.

Although no candid inquirer could doubt that Van Helmont anticipated the invention of the differential thermometer, yet there was one little loop hole in his description of it through which a person of small dimensions might creep; and in this way, from a slight flaw in the indictment, the differential thermometer has been allowed to preserve a kind of separate existence.

Abandoning therefore the cause of Van Helmont, though a good one, we are now prepared to *prove*, that the differential thermometer was invented by John Christopher Sturmius, Professor of Mathematics at Altdorff, who published an accurate account of its construction and theory, illustrated by drawings, in his *Collegium Experimentale Curiosum*, which was published at Nuremberg in 1676. Professor Sturmius calls it a *thermometer* and also a *thermoscope*, the very name used by Count Rumford; and he describes no fewer than *five* varieties of them, of which his own is the *third*. The *first* thermoscope consists of a thermometer tube, with a ball at the end of it containing air. This tube with the air ball uppermost, is placed with its open end in a vessel of coloured liquor. The degree of heat, by the expansion of the air in the ball which pushes down the fluid, is marked upon a scale attached to the tube. In the *second thermoscope,* the air-ball is at the lower end of a tube like the letter *l,* and there is a small hole in the ball at the upper end, to allow the coloured fluid to rise when the air in the lower ball is expanded by heat.

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* Mr. Leslie's book on heat appeared in 1804. Count Rumford's paper was read before the Royal Society on the 2d February 1804.

The *third* thermoscope, which is the differential thermometer, is a combination of these two, and is represented in Plate II. Fig. 20. The following is Sturmius's own description of it. " Tertium e duobus prioribus ferme compositum sic habebat: Parato posteriori genere ABCD plane ut antea, super imposita est et firmiter agglutinata ejus extremitati apertae D, sphaerula E in eum finem seorsim fabrefacta; ita ut jam aeri nec ingressus nec egressus pateret. Hic, dum calida manus applicabatur sphaerulae E, summa superficies spiritus inclusi C descendebat; si frigidum quippiam, ascendebat: contrarium autem plane fiebat admotis istis sive calidis sive frigidis ad inferiorem sphaerulam A. Solius viro aeris liberi calori exposito instrumento, sphaera A (quam notetur angustiorem fuisse notabiliter altera E) semper prevalebat et sola operabitur: ita scil. ut incalescente magis aere liquorem a C sublevarit, ac ad ascensum cogeret; ad descensum contra, cum calor aeris remitteret et plus frigoris succederet. Notandum tamen ascensus istos ac descensus liquoris, sive a liberi aeris, sive ab admotarum rerum calore vel frigore causatos, ad minus notabile spatium se extendisse, seu vias breviores confecisse, quam in genere precedenti." Page 49, 50.

In explaining the theory of the instrument, he goes on,

" In *tertio* genere nihil equidem agit aer externus, utpote penitus exclusus; eodem tamen res recidit, cum et superus aer EC et inferus AB ad equalitatem virium redacti, medium aquae cylindrum CB immotum tamdiu sustineant, quamdiu alterutrius vires non augentur notabiliter. Utri ergo primum nova vis accesserit, is alterum vincens aquae cylindrum a se removebit; et contra, utri accedens frigus aliquid virium detraxerit, is alteri cedens aquei cylindri pondere arctius urgebitur et comprimetur. Quod si contingat utrumque equali caloris gradu in aere libero rarefieri, tunc superum CE, quippe copiosiorem, vincere, et inferum BA cedere, necessum alicui videatur, quia tunc partibus aequalibus singulis utriusque aeris aequalis vis expansiva per rarefactionem accrescat, tales autem partes plures habeat aer superior quam inferior. Verum cum contrarium nunc accidat, ratio videtur e praecedanea majore aeris AB condensatione petenda." Page 54.

In an appendix to this work, Sturmius goes on to discuss the properties of his thermometer, and he mentions that the Dutch artists, in place of agglutinating the ball E to the stem at D, leave an opening at A, which is afterwards hermetically sealed. He then mentions an experiment, in which he muffles up the lower ball A, and exposes E to the action of the solar rays. The liquid then descended, as the air in the sphere DE became warmer. " In quo meo ratiocinio penitus confirmor ipso momento, *dum hoc ipsum thermometrum meum,* de quo hic ago, involuta prius muccinio sphærula inferiore A, ita fenestræ admoveo ut sola superior a meridiani solis radiis feriatur, videoque nunc liquorem sensim descendere, prout aer sphæræ DE magis magisque incalescit." Page 89. *App.*

This amiable author then proceeds to consider who first invented the thermometer. "Ecquisnam primus fuerit thermoscopii inventor, vix constat. Aliqui, quos inter supra laudatus Lana, *Roberto Fludd* seu à *Fluctibus* id honoris tribuunt, *Samueli Reyhero* autem, Mathem. in alma Kilonensi Prof. P. videtur prima inventio deberi Drebbelio." P. 89, 90.

These passages, which we purposely leave untranslated, settle for ever the invention of the differential thermometer; and as we and many others know that Mr. Leslie has read and studied the *Collegium Curiosum* of Sturmius, we trust that he will avail himself of the first opportunity, both in his lectures and in his writings, of restoring voluntarily to that amiable and learned Professor the honour of an invention which so unquestionably belongs to him.

In a future number, we shall proceed to rectify the history of the *Hygrometer*, the *Photometer*, the *Æthrioscope*, the *Drying* and the *Freezing* processes, &c. &c. &c. of Professor Leslie, which we trust we shall illustrate as successfully as we have done that of the differential thermometer.

In the mean time, we proceed to other claims.

2. *Daniell's Platina Pyrometer, partly anticipated by M. Guyton.*

Our scientific readers are no doubt well acquainted with the merits of Mr. Daniell, to whom we owe many excellent inventions and admirable memoirs on scientific subjects. In the year 1821, he published in the *Quarterly Journal of Science*, (vol. xi. p. 309.) a description of a pyrometer for high degrees of heat, which consisted of a platina bar placed within a tube of black lead earthen ware. The expansion of the bar was indicated upon a circular scale, through the intermedium of a platina wire acting upon the axis which carried the index.

Mr. Daniell does not seem to have been aware that M. Guyton had exhibited to the National Institute in 1803 a similar instrument, consisting of a rod or plate of platina, placed in a groove formed in a cake of hardened white clay. One of the ends of the platinum bar presses against a bended lever of platina, whose longest arm forms an index to a graduated arc.

The principle of these instruments is the same, both of them depending on the difference of the expansions of pottery and platina; but they differ in this, that the whole of Guyton's instrument is put into the furnace, whereas, in Mr. Daniell's, the platinum bar is alone exposed to the heat, the index and scale being kept at a distance from it. See the *Ann. de Chim.* No. 138, vol. xlvi. p. 274, Nicholson's Phil. Journ. vol. vi. p. 89, and the Edinburgh Encyclopædia, Art. PYROMETER, vol. xvii. p. 215, where both of them are described.

3. *Mr. Nicholas Mill's Pyrometer, anticipated by Dr. Ure.*

In the year 1824, Mr. Nicholas Mill published in the *Monthly Medico-Chirurgical Review, &c.* a drawing and description of a pyrometer, consisting of a hollow bulb and tube of platina containing air, the expansions of which were indicated by its action upon a column of mercury in a vertical glass tube, contained within the platinum tube. Dr. Ure, however, in his *Dictionary of Chemistry*, published in 1821, has proposed the *very same instrument*, with more minute details respecting the graduation of its scale. These two instruments are fully described in the article PYROMETER, in the Edinburgh Encyclopædia, Vol. XVII. Part I. just published.

ART. XXVII. HISTORY OF MECHANICAL INVENTIONS AND PROCESSES IN THE USEFUL ARTS.

1. *Mr. Vallance's Apparatus for Freezing Water.*

THE apparatus described by Mr. Vallance is represented in Plate II. Fig. 17. and is founded on the principles of freezing in the air-pump, discovered, as our author states, by Dr. Cullen and Mr. Nairne, and improved by Mr. Leslie. This method consists in passing a current of dry rarefied air over the extended surface of the water, which, by impinging on it, carries off the aqueous vapours. The water is placed in a flat bottomed vessel *aa*, so as to form a stratum about half an inch deep. The greater part of the air is to be removed from the vessel through the pipe *b* by two good air-pumps, till the pressure of the air within will support about an inch of mercury. A hollow tube *c* passes through a stuffing-box in the lid of the vessel *a*, where it is enabled to slide up and down, and has at its bottom a circular plate or disc *d*, which is brought to within half an inch of the water, and rises a little conically in the middle.

Another similar tube *e* is attached by flanges to the upper end of *c*, and passes through a stuffing-box in the upper vessel *f*, from which a bent pipe *g* passes into another vessel *h*, which is nearly filled with leaden bullets, and has a small air-hole below. A quantity of sulphuric acid is occasionally poured on these bullets to wet their surface. Several air-holes are made in the lid of the vessel *a*, and also in the plate *d*, and are closed air-tight with glass, to show the progress of the operation within.

When the air-pump draws the air from the vessel *a*, the stop-cock *g* is to be partly opened, so as to admit air as fast as the pumps exhaust it. This air passes between the leaden balls in *h*, and has its aqueous particles absorbed by the acid. A current of dry air thus passes from *h* through the pipe *g*, the vessel *f*, the tubes *e* and *c*, and descends upon the surface of the water under the disc *d* in the vessel *a*. This current of air being drawn off by the air-pumps through *b*, carries off the heat from the water and makes it freeze. After one stratum is frozen, more water is introduced into *a*, so as to be about half an inch deep on the ice, and this is frozen by a similar operation, till the vessel is filled up with ice. See Newton's *Journal of the Arts*, vol. viii. p. 251.

2. *Account of Mr. Dalton's Process for determining the Value of Indigo.*

In order to find the value of any sample of indigo, Mr. Dalton directs us to take one grain, carefully weighed from a mass finely pulverised. Put this into a wine glass, and drop two or three grains of concentrated sulphuric acid upon it. Having triturated them well, pour in water, and transfer the coloured liquid into a tall cylindrical jar, about one inch inside diameter. When the mixture is diluted with water, so as to show the flame of a candle through it, mix the liquid solution of oxymuriate of lime with it, agitating it slowly, and never putting any more in till the smell of the preceding portion has vanished. The liquid soon becomes transparent, and of a beautiful greenish-yellow appearance. After the dross has subsided, the clear liquid may be passed off, and a little more water put into the sediment, with a few drops of oxymuriate of lime, and a drop of dilute sulphuric acid; if more yellow liquid is produced, it arises from particles of indigo which have escaped the action of the oxymuriate before, and must be added to the rest. The value of the indigo Mr. Dalton considers to be in proportion to the quantity of real oxymuriate of lime necessary to destroy its colour. He is of opinion also, that the value may be well estimated by the quantity and intensity of the amber-coloured liquid which the indigo produces, which is found independently of any valuation of the oxymuriate of lime. The following results obtained with several samples, show the great value of this method.

	Oxymuriate of lime used to destroy its colour.
Precipitated and sublimed indigo . . .	140 grains.
Flora indigo	70
Another sample	70
Two other indigos	60
Two other samples	50
Another sample	40
Another sample	30 or 35.

Mr. Dalton is of opinion, that to destroy indigo by oxymuriatic acid, twice the quantity of oxygen is necessary that is required to revive it from the lime solution. See *Manchester Memoirs*, New Series, vol. iv. p. 437, 438, 439.

3. *Mushet's Process for alloying Copper for Ships.*

In order to increase the tenacity of pure copper, to render it more fibrous, and to prevent the common effects of sea-water upon it, Mr. Mushet has taken out a patent for the following process:—

He mixes with the copper, as an alloy, regulus of zinc, in the proportion of two ounces of zinc to 100lbs. weight of copper; or two ounces of block or grain tin; or four ounces of regulus of antimony; or eight ounces of regulus of arsenic, in the same quantity of copper. Or, instead of employing these substances alone in the above-mentioned proportions, to 100lbs. of copper he proposes to add half an ounce of regulus of zinc, half an ounce of grain or block tin, one ounce of regulus of antimony, and two ounces of regulus of arsenic.

4. *Mr. Mackintosh's process for rendering impervious to water and air all kinds of Cloths; also Leather and Paper, &c.*

This very valuable process, which we owe to the ingenuity of our countryman Mr. Charles Mackintosh, consists in joining the surfaces of two pieces of cloth by a flexible varnish, made of caoutchouc dissolved in the naptha obtained from the distillation of coal. The caoutchouc, after being cut into thin shreds, is steeped in the varnish composed of twelve ounces of caoutchouc to one wine glass full of the oil. Heat may be applied, and the thick varnish must be strained through a sieve of wire or horse-hair. The cloth is stretched on a frame, and then covered by means of a brush with a coat of the elastic varnish. When the varnish has become sticky, another piece of similar cloth, similarly varnished, is laid upon the first, the surfaces being placed face to face; and, to promote the adhesion, they are pressed between a pair of plain rollers, and then dried in a warm room. This cloth, of which we have now several very fine specimens before us, besides being used for outer garments to keep off rain, will be found highly useful for various purposes in the arts and sciences.

5. *M. M. Farrimann and Thilly's Process for rendering Leather, Canvass, Linen, &c. Water Proof.*

To 100 lbs. of the best linseed oil add 1½ lb. of sugar of lead, (acetate of lead,) 1¼ lb. of coloured amber, 1½ lb. of white lead, and 1½ lb. of pumice stone, very finely powdered. When the solid substances are well ground and mixed, they are to be boiled in the oil for ten hours over a moderate fire, to prevent the oil from burning. The varnish thus made ought to have such a consistence, that when mixed with a third part of its weight of pipe clay, it is as thick as treacle. After settling for eight days, it is then passed through a lawn sieve. In a solution of strong and clear glue, as much pipe clay is to be ground as amounts in weight to the tenth part of the oil employed, and mixed to the consistence of ointment, adding the varnish by degrees, and stirring it with a wooden spatula. When this varnish has become perfectly fluid by repeated stirring, the requisite tint is given, by adding a fourth part of the colour ground in oil.

The composition is applied to each side of the linen, when stretched on a wooden frame, with a spatula three inches broad and nine long. The same composition is used for leather and skins; but a smooth and brilliant surface is given to them by the following varnish: Five pounds of the oil varnish, and an equal weight of well-clarified resin, are boiled, till the resin is absorbed. Two pounds of oil of turpentine, having the required colour ground with it, is then to be added, when passed through a lawn sieve. This varnish is then to be applied with a brush. When the varnish is perfectly dry, it is rubbed even with a pumice stone and water, and then washed clean. Two or three coats of varnish being applied to the leather, &c. and each coat permitted to dry for two or three days, a brilliancy equal to that of Japan lacker will be produced.—*Bulletin de la Société d'Encouragement, &c.* or Gill's *Tech. Repos.* May 1824, p. 320.

6. *Siemen's Improvement on the Process of making Brandy from Potatoes.*

The introduction of this process, which has been adopted in many parts of Germany and in the north of Europe, has been recommended to the Swedish government by M. Berzelius, and to the Danish government by Professor Oersted. From the trials made at Copenhagen, it would appear that one-third more brandy is produced than by the usual processes. In Professor Oersted's report, we find the following account of the process. The potatoes are put into a close wooden vessel, and exposed to the action of steam, which heats them more than boiling water. The potatoes can thus be reduced to the state of the finest paste with the greatest facility, it being necessary only to stir them with an iron instrument furnished with cross pieces. Boiling water is then added to the paste, and afterwards a little potash, rendered caustic by quicklime. This dissolves the vegetable albumen which opposes the complete conversion of the potato starch into a fluid. Professor Oersted frees the potato brandy from its peculiar flavour by means of the chlorate of potash, which is said to make it equal to the best brandy made from wine.—Gill's *Tech. Repos.* No. 29, p. 322.

7. *Account of Improvements on Thin Circular Saws.*

In order to prevent thin circular saws from bending, or *buckling* as it is termed, they are generally confined between two flat circular plates. The improved method, however, consists in *confining the binding to a more narrow ring near the periphery or rim of the saw.* By this simple contrivance, the saw revolves with such truth and accuracy that it is fit for the nicest operations, such as cutting the teeth of the finest combs. The gentleman who communicated to Mr. Gill this contrivance, always softens his circular saws when their teeth require sharpening, which greatly facilitates the operation. He tempers them only to a yellow colour, by which they last much longer than when they are tempered to the spring temper. Mr. Gill likewise mentions, that the late Mr. S. Varley prevented the very common evil of the bending of the saw-arbor, which arises from the imperfection of the screw upon it, by forming the external face of one of the circular plates convex, and the face of the binding screwed nut concave; both being portions of spheres of the same diameter. They were thus allowed to ply or yield to the irregularity of the screw, which could not take place when their surfaces were made flat as usual.—See Gill's *Tech. Repos.* No. 31, p. 64.

8. *On the Invention of Floating Breakwaters.*

We have much pleasure in inserting the following article, which is the substance of a letter addressed to us by David Gordon, Esq. already well known to the public as the ingenious inventor of the portable gas lamps:

"As Mr. White has lately taken out a patent for a floating breakwater, and you have noticed it in your *Edinburgh Journal of Science* as a new invention, I beg leave to refer you to the *Repertory of Arts*, Vol. XLI. page 206, wherein you will find the specification of my patent, dated 14th January 1822, for improvements on floating breakwaters, a copy of which I sent to you, and of which you gave a short notice in the *Edinburgh Philosophical Journal* for October 1822. Vol. VII. page 373.

"In fact I had, from observing the effects of a field of ice aground betwixt two islands, and at the mouth of a bay, and large American rafts anchored in similar situations, many years ago, contrived a floating breakwater, and for a long time thought myself the first inventor thereof, but upon returning to this country, I discovered that General Bentham had proposed to make floating breakwaters in separate parts or floats of wood, to make the floats of a triangular or rather a prismatic shape, and to hold them in their places by means of iron chains, &c.; and that he had actually given in a plan and estimate for forming the breakwater at Plymouth of *wooden floats*, the cost of which he calculated at L.201,826. Under these circumstances, I saw that it was impossible to claim being the first inventor of floating breakwaters, and limited my claim to improvements thereon.

"I humbly think that both General Bentham's and Mr. White's plans are defective in several particulars, even in others than I could include in my specification, and which I propose to give an account of in some observations on sea walls, piers, and breakwaters."

ART. XXVIII.—ANALYSIS OF SCIENTIFIC BOOKS AND MEMOIRS.

I. *Der Monte Rosa. Eine Topographische und Naturhistorische Skizze nebst einem Anhange der von Herrn Zumstein gemachten Reisen zur Ersteigung seiner Gipfel.*

Monte Rosa. A Topographical and Historical Sketch, with an Appendix of the Journies of M. Zumstein to these Summits. By LOUIS BARON DE WELDEN. With a Topographical Chart and Lithographic Plates. Vienna. 1824.

WHILE Monte Rosa was regarded as inferior in altitude to Mont Blanc, it enjoyed a sort of peaceful existence, which was neither disturbed by the approach of travellers nor by the hammer of the Geologist. No sooner, however, was it conjectured that it was the king of European mountains, than travellers flocked to it from different quarters. Its ridges were ascended, its ravines explored, its rocks broken up, and memoirs written in commemoration of its newly acquired sovereignty.

In our last Number we gave a translation and abstract of the very interesting journey which M. M. Zumstein and Vincent performed to one of its summits, and we stated the trigonometrical observations by which they obtained, from its most elevated peak, an altitude exceeding that of Mont Blanc. It appears, however, that these observations were not correctly made, and that Mont Blanc is still entitled to the highest dignity among our European mountains.

The following are the observations which have been made at different times upon the height of Monte Rosa.

	Toises.	
In 1788, M. Oriani, from Milan	2389	
from Mont Generoso	2391	
In 1803, from Milan	2385	
In 1824, M. Carlini, from Milan	2374	
from Turin	2343	
from Superga	2357	
from Mondovi	2319	Rejected.
In 1822, Baron Welden, from Monte Carnero	2370	
Mean height of Monte Rosa	2373	

The following observations have been made at various times on Mont Blanc.

	Toises.
In 1796, M. Tralles	2468
In 1821, M. Carlini, from Mont Colombier	2460
The Austrian Engineers from Mont Trelod	2462
from Perron d'Encombres	2459.9
from the Glacier of Ambin	2463.9
from Roche Melon	2458.8
The French Engineers from Mont Granier	2460.1
Mean height of Mont Blanc	2461.8
Do. of Monte Rosa	2373.0

Hence, Mont Blanc is higher than Monte Rosa by - 88.8 Toises.

As some persons have claimed for Mont Oerteles, in the Tyrol, an elevation equal to that of Mont Blanc, we shall give the following measures of its height, as obtained in 1818 by the Austrian engineers, from the triangulation which they then conducted in the Tyrol.

	Toises.
In 1818, from Pflinn Spitze	2012.5
from Monte Motto	2010.1
from Corno di S. Colombano	2009.5
from Pizzo del Ferro	2010.0
Mean height of Oerteles	2010.5
Height of Mont Blanc	2461.8

Hence Mont Blanc is higher than Oerteles by - 451.3 Toises.

Although Monte Rosa is thus deprived of the honour of being placed at the head of our mountains, yet it has acquired a new degree of interest during its temporary elevation. Baron Welden, the author of the present work, conceived the laudable design of exploring and describing the topography, the orometry, the geology, the natural history, and the botany of this mountainous region.

Monte Rosa is finely seen from the rich plains of Lombardy. It is seen distinctly from the Gulf of Genoa, while Mont Blanc is concealed behind the mountains of Cogne and Saone. Baron Welden has observed Monte Rosa from the whole chain of the Appenines, from *Sasso di Castro,* above Loano, on the road from Florence to Bologna, from Monte Cimone, on the road from Modena to Pistoja, from Lacissa of Pontremoli at Parma, and also from the Col de Tende. In general it is seen in all directions to the south and the east, as the view of it is not interrupted by any mountains of sufficient altitude. Towards the east it is seen from the whole chain of Mont Cenis; and Baron Welden has observed it from all the chain of the Oberland in Berne, which stretches from the Gemmi and the Diablerets to the lake of Geneva.

Monte Rosa was called by the ancients *Mons Sylvius,* a name which was afterwards conferred on its neighbour, Mont Cervin. The name of Monte Rosa seems to have been first given to it by Scheüchzer, in his *Itinera Alpina* in 1702—1711; and Baron Welden thinks that it derives its name from the roseate tints which the first rays of the rising sun throw upon its whitened summits.

The summit of Monte Rosa has not yet been reached by any traveller. One Maynard pretended that he had reached the summit on the 13th of August, 1813; but it is evident from his own account, that the point which he attained was very far from the summit. In 1817 Professor Parrot of Dorpat, along with M. Zumstein of Gressonay, made two attempts to ascend this mountain, but both of them failed.

In 1819, M. Zumstein performed the interesting ascent of one of its southern summits, which we have published in our first number. He made a second ascent in August 1820; a third in August 1821; a fourth in July 1822; and a fifth in August of the same year; an account of all of which is published at the end of Baron Welden's work.

After Baron Welden has given an account of the various triangulations connected with Monte Rosa and the Swiss Mountains, he gives a table of the height of the European mountains which have been accurately measured, and which is too valuable to be omitted.

FIRST CLASS.

	Paris feet.		Paris feet.
Mont Blanc - -	14,764	Monte Rosa, 4th Peak -	12,984
Monte Rosa, 1st, or highest Peak	14,222	5th Peak -	13,650
2d, Peak	14,154	6th Peak -	12,984
3d, Peak	14,028		

SECOND CLASS.

	Paris feet.		Paris feet.
Mont Cervin, *Saussure*	13,854	Le Geant	13,044
Finster Aarhorn, *Tralles*	13,234		

THIRD CLASS.

	Paris feet.		Paris feet.
Mountain between the valley of Matter and Saas	12,882	Eigner, *Tralles*	12,368
Jungfrau, *Tralles*	12,872	Mountain N.W. of Briançon	12,138
Mönch	12,666	Point Oerteles, Tyrol	12,059
The Great Peloux, W. of Briançon	12,612	Aiguille du Midi	12,054
Shreckhorn, *Tralles*	12,560	Breithorn, *Saussure*	12,012
Iseran in Savoy	12,456	Glockner in Salzburg, *Schiegg*	11,988
		Monte Viso, *M. Plana*	11,808

FOURTH CLASS.

	Paris feet.		Paris feet.
Zebru Konigs-Spitze, near Oerteles	11,516	Sustenhorn	10,910
Wetterhorn, *Tralles*	11,453	Roche Melon, S. E. of Mont Cenis	10,878
Altes	11,432	Titlis, *Saussure*	10,818
Aiguille D'Argentiere, *Raymond*	11,412	Aiguille d'Arve, Savoy	10,776
Frau, *Tralles*	11,393	La Pelouse, Savoy	10,775
Dent Parassée, Savoy	11,388	Mont Perdu, Pyrenees	10,518
Gallenstock	11,330	Monte Confinale, near Oerteles	10,392
Monte delle Disgrazie	11,316	Glacier d'Ambin	10,380
Weissbachhorn, Salzbourg	11,300	Vigne Male	10,374
Doldenhorn, *Tralles*	11,287	Moschelhorn	10,280
Monte Tresero	11,136	Mount Etna, *Shuckburgh*	10,254
Roche St. Michael, the highest point of Mont Cenis	11,058	Pizzo Scalino	10,248
Dœdi	11,839	Liconcio	10,221
La Rame in Savoy	10,968	Poz Valrhein	10,220
Monte Adamello, Tyrol	10,950	Glacier de Chardon	10,200

After giving an account of the trigonometrical operations among the Alps, and the longitudes, latitudes, and heights of the principal mountains and peaks, Baron Welden treats, at great length, of their zoology, botany, and topology, of the vegetation of the mountains, of the line of perpetual snow, and of their glaciers, torrents, and mines. He gives also a very interesting account of the inhabitants of the valleys around Monte Rosa which is encircled by a German population, who have preserved their customs and language entire. This German population to the south and east of Monte Rosa amounts to 9000, of whom 4000 inhabit the valley of the Lys, where there are two parishes and several hamlets. The other 5000 are dispersed in the parishes of Allagna and Mucugnaga.

The plates of this work are very interesting. Besides the map of the triangles, there are five small views of Monte Rosa executed by the Camera Lucida, viz. a view of Monte Rosa from the Lago D'Orte; a second from Turin; a third from Vercelli; a fourth from Gemmi; and a fifth from Rothorn. The last of the plates is a fine topographical chart of Monte Rosa and its environs, on a scale of 3200 toises to a Paris inch. It is finely engraved by Bonati of Milan, and is considered by Baron Zach, a competent judge, as a perfect model for topographical charts.

II. *Memoirs of the Literary and Philosophical Society of Manchester. Second Series,* vol. iv.

Nothing has contributed more to the advancement of science, and to the diffusion of general knowledge in Great Britain, than the establishment of Provincial Societies for literary and philosophical purposes. Among these institutions, which are every year increasing in number, the Society of Manchester has long held a distinguished place, and continues to sustain its high character, under the auspices of Mr. Dalton and Dr. Henry;—names which have long been associated with some of the finest discoveries in chemical science.

The present volume, which we propose only briefly to notice, contains *sixteen* papers, *five* of which are literary, and *eleven* scientific.

The first scientific paper is by Mr. Dalton, and is entitled, *On Oil, and the Gases obtained from it by Heat.* As this paper was read so long ago as 1820, the results which it contains have been in some measure superseded by later observations. Mr. Dalton found that oil gas is not altered by being kept two or three years over water or mercury, either by itself, or in mixture with three or four times its bulk of oxygen gas. He found that oil gas was highly absorbable by water, about sixty per cent being absorbed. The gas expelled from the water was richer than the original, or contained more superolefiant gas, both from the increase of carbonic acid, and of the requisite oxygen. Mr. Dalton considers it as nearly demonstrable, that oil gas is a mixture of carburetted hydrogen, carbonic oxide, and hydrogen, with a greater or less portion of a gas *sui generis,* consisting of the elements of olefiant gas, united in the same proportion, but differing in the number of atoms.

In a note appended to the volume, and dated July 1824, Mr. Dalton adds the following important information on this subject: "From a recent train of experiments, I found that the heat from the combustion of those gases is accurately, or very nearly, in proportion to the oxygen consumed, and that whether the gases are diluted or not; but the light is nearly in the compound ratio of the oxygen consumed, and the density of the combustible gas, *when the last is nearly pure;* but if it is diluted with any incombustible gas, or even with hydrogen, the diminution of light is vastly greater than in proportion to the dilution. I find one cubic foot of oil gas (spec. grav. 0.9) equivalent to 2 or 2¼ of coal gas (spec. grav. 0.6) for the purpose of illumination." Page 527.

The next scientific paper, also by Mr. Dalton, is entitled *Observations in Meteorology, particularly with regard to the Dew Point, or Quantity of Vapour in the Atmosphere.* These observations were made from 1803 to 1820, on the mountains in the north of England, with the view of ascertaining whether or not there existed a distinct vapour atmosphere, mechanically blended with the common one, but acting by its own tension or elasticity, and being subject to condensation by cold exactly in the same manner as an insulated atmosphere of steam would be. Mr. Dalton's observations, however, though original in their nature and design, do not in his own opinion establish the existence of such an atmosphere. The following are the results which their author has deduced from them:

1. That the quantity and density of vapour is constantly (or with very rare exceptions) less the higher we ascend.

2. That wherever a dense cloud or fog exists, then the temperature of the air and the dew point are the same.

3. That when a mountain is wholly, or in great part, enveloped in fog, there is little variation in ascending, either in the temperature of the air, or in the dew-point.

4. That, upon an average, the temperature of the air sinks after the rate of 1° for every 80 yards of perpendicular ascent, about the middle, or warmest part of the day; and that of the dew-point 1° for every 130 yards perpendicular ascent.

5. That the phenomena of aqueous meteors, such as rain, fog, dew, &c. depend upon the known relations of heat and water, and are exhibited to us in miniature every day in our domestic economy. Electricity appears to be a consequent, rather than an agent, in the formation and decomposition of clouds; or, if a necessary agent, it is equally so in the boiling of water, or in the drying of piece-goods in a stove.

Mr. Dalton concludes his paper with the following useful Table, which exhibits in numbers the drying power of the air, according as its temperature is elevated above that of the dew-point.

Dew Point.	Temperature of the air above the Dew Point.									
	2	4	6	8	10	12	14	16	18	20
30	8	16	24	32	41	51	63	74	86	98
35	9	17	26	37	48	61	72	85	99	114
40	10	22	33	45	57	71	85	100	117	135
45	12	24	37	51	66	81	99	117	135	154
50	14	28	43	60	78	96	115	135	155	178
55	16	33	51	69	88	109	131	155	181	209
60	18	37	57	77	100	126	153	182	213	244

The next paper in this volume is a very elaborate and interesting one, entitled, *Tables of the various Species of Periodical Birds observed in the neighbourhood of Manchester, with a few Remarks, tending to establish the opinion that the Periodical Birds Emigrate;* by Mr. John Blackwall. The following tables will exhibit Mr. Blackwall's arrangement of periodical birds, and the principal facts which he has observed.

TABLE I.—*Periodical Summer Birds.*

		Appear.	Disappear.
Sand Martin	Hirundo riparia	April 6	Sept. 16
Wryneck	Yunx torquilla	do.	
Water Wren	Motacilla trochilus	do. 12	do. 12

		Appear.	Disappear.
Redstart	Motacilla phoenicurus	do. 13	do. 5
Wheatear	Motacilla oenanthe	do. 14	do. 13
Swallow	Hirundo rustica	do. 18	Oct. 11
Whinchat	Motacilla rubetra	do. 20	Sept. 17
Black-cap	Motacilla atricapilla	do. 22	do.
Martin	Hirundo urbica	do. 23	Oct. 13
Cuckoo	Cuculus canorus	do. 24	June 28
Yellow Willow Wren	Motacilla sylvicola	do. 28	Sept. 10
Stonechat	Motacilla rubicola	do.	do.
Sandpiper	Tringa hypoleucos	do. 29	do. 19
Grasshopper Warbler	Motacilla locustella	do. 30	
Whitethroat	Motacilla sylvia	May 2	do. 17
Swift	Hirundo apus	do. 8	Aug. 18
Petty chaps	Motacilla hortensis	do. 12	Sept. 11
Land Rail	Rallus crex	do. 14	do. 30
Fly-catcher	Muscicapa grisola	do. 14	do. 13
Hedge Warbler	Motacilla salicaria	do. 19	
Red-backed Shrike	Lanius collurio	do.	
Goat-sucker	Caprimulgus Europeus		do.

TABLE II.—*Periodical Winter Birds.*

		Appear.	Disappear.
Snipe	Scolopax gallinago	Sept. 28	March 31
Redwing	Turdus Iliacus	Oct. 9	do. 26
Mountain Finch	Fringilla montifringilla	do. 18	April 14
Woodcock	Scolopax rusticola	do. 26	do. 2
Jack Snipe	Scolopax gallinula	do.	
Fieldfare	Turdus pilaris	Nov. 1	March 18
Water Rail	Rallus aquaticus		

TABLE III.—*Birds irregular in Appearing and Disappearing.*

		Appear.	Disappear.
Crossbill	Loxia curvirostra	Aug. 5	Nov. 19
Siskin	Fringilla spinus	Dec.	
Chatterer	Ampelis garrulus		
Hoopoe	Upupa epops		
Great Shrike	Lanius excubitor		

TABLE IV.—*Birds partially Periodical.*

		Appear.	Disappear.
Throstle	Turdus musicus	Feb. 4	Nov. 2
Starling	Sturnus vulgaris	do. 9	Aug.
Green Grosbeak	Loxia chloris	do. 25	Oct. 23
Common Bunting	Emberiza miliaria	March 3	
Pied Wagtail	Motacilla alba	do. 11	do. 16
Red Bunting	Emberiza schoeniclus	do. 17	Sept.
Lesser Redpole	Fringilla linaria	April 3	Nov. 5
Yellow Wagtail	Motacilla flava	do. 17	Sept. 10
Lapwing	Tringa vanellus	do.	
Merlin	Falco æsalon	Oct.	
Grey Wagtail	Motacilla boarula		April
Ring Ouzel	Turdus torquatus	Dec.	

Mr. Blackwall proceeds to inquire if there is any connexion between the mean temperature of the times of the appearance and disappearance of periodical birds; but it is quite obvious from his tables, and from similar tables in other latitudes, that the weather is, generally speaking, much colder when they appear than when they disappear, from which we should be disposed to draw the conclusion, that they have a greater affection for our temperate one than for the warm climate to which they emigrate in winter.

In order to show that the periodical birds migrate to warmer climates, in place of becoming torpid in winter, as has been supposed by some naturalists, Mr. Blackwall derives his principal arguments from the absurdity of the latter opinion. He also argues from the important fact, that several species of periodical summer birds moult during the interval that elapses between their departure and re-appearance; and he considers it ridiculous to suppose that these birds could throw off their old feathers and put on new ones, if they were in a state of torpidity, or if their animal functions were entirely suspended.

Mr. Blackwall has enriched this volume with other two papers, one *On the Notes of Birds, including an Enquiry whether or not they are instinctive,* and another *On the Cuckoo.*

In the first of these papers, he clearly shows, in opposition to Daines Barrington, that the notes of birds are instinctive, and do not " depend on the master under whom they are bred." His principal observations are arranged in tables, which we cannot withhold from our readers, and which we have thrown into one.

TABLE V.—*Catalogue of Singing Birds, with the time of their beginning and ceasing to sing, from a mean of five years' observation, with the numerical value of their notes, twenty being that of absolute perfection.*

	Begins.		Ends.		Mellowness.	Sprightliness.	Plaintiveness.	Compass.	Execution.
Redbreast	Jan.	3	Dec.	14	9	8	12	14	14
Wren	do.	13	do.	3	1	16	0	4	5
Missel Thrush	Feb.	1	May	28	3	4	1	5	3
Throstle	do.	8	Aug.	12	3	10	2	10	4
Skylark	do.	9	July	8	4	19	4	18	18
Hedge Warbler	do.	9	do.	19	3	4	3	4	4
Chaffinch	do.	10	do.	7	2	14	1	4	5
Starling	do.	15	May	30	4	2	2	4	2
Blackbird	March	20	July	13	8	1	4	5	3
Green Grosbeak	do.	24	Aug.	12	5	3	5	5	5
Titlark	April	4	July	9	3	2	2	2	2
Lesser Redpole	do.	5	Aug.	5	1	4	0	3	3
Woodlark	do.		Oct.	25	18	2	17	8	6
Goldfinch	do.	11	June		4	16	4	10	12
Redstart	do.	14	do.	29	1	4	0	2	2
Willow Wren	do.	14	Aug.	23	6	4	5	5	5
Linnet	do.	15	July	6	10	15	6	12	13
Lesser Field-Lark	do.	17	do.	8	8	7	5	4	5
Swallow	do.	19	Sept.	25	4	6	2	3	3
Stonechat	do.	24	June		1	3	0	3	2
Whinchat	do.	25	July	1	1	3	0	2	2
Blackcap	do.	25	do.	22	14	12	12	10	8
Whitethroat	do.	29	do.	16	1	4	0	3	3
Pettychaps	May	12	do.	11	14	6	14	10	9
Sedge Warbler	do.	17	do.	16	2	16	0	18	14

Mr. Blackwall's *Observations on the Cuckoo,* will be read with much interest by naturalists. He confirms, in general, the interesting results obtained by the late Dr. Jenner, and we regret much that we cannot find room for an abstract of his ingenious observations.

The other scientific papers in this half volume, are *On the Transverse Strain and Strength of Materials;* by Mr. EATON HODGKINSON. This is a paper of great interest and value, and we may probably return to it at some future opportunity.

On the Saline Impregnations of the Rain which fell during the late Storm, December 5th, 1822; with an appendix to it; by John Dalton, F. R. S. An abstract of this paper is given in our Scientific Notices.

On the Nature and Properties of Indigo; by JOHN DALTON, F.R.S. The principal part of which we have already given in our *History of Mechanical Inventions and Processes in the Useful Arts,* p. 149.

Experiments on the Analysis of some of the Aeriform Compounds of Nitrogen; by WILLIAM HENRY, M. D. F. R. S. See our last Number, p. 377. for an extract from this ingenious paper.

III. *Account of the Bell Rock Light House; including the Details of the Erection and peculiar Structure of that Edifice.* 1 vol. 4to. pp. 534. By ROBERT STEVENSON, Esq. F. R. S. E. Civil Engineer.

> "Far in the bosom of the deep,
> O'er these wild shelves my watch I keep,
> A ruddy gem of changeful light.
> Bound on the dusky brow of night,
> The seaman bids my lustre hail,
> And scorns to strike his timorous sail."
>
> SIR WALTER SCOTT.

IF England has justly boasted of the Eddystone Lighthouse as one of the greatest public works of the age in which it was erected, and if the skill and intrepidity with which it was planned and executed, have reflected immortal honour on the name of Smeaton, Scotland may, with equal justice, be proud of the Bell Rock Lighthouse, and may claim an equal share of reputation to Mr. Stevenson, for the skill, and intrepidity, and patience with which he has planted that magnificent beacon upon our stormy coast. The erection of a bridge, the formation of a canal, or, indeed, any of the common works of the civil engineer, require only those ordinary resources both of mind and machinery which long experience has sanctioned; but in the erection of a lighthouse, upon a submerged rock in the bosom of a stormy sea, the engineer is thrown upon new resources, of which neither theory nor experience furnishes him with any knowledge. His building is subjected to strains different from those of gravity; his materials are exposed to disintegrations worse than the corrosions of time or weather; and every part of his operations, however trivial they may be on dry land, requires precautions and combinations which nothing but patience, and temper, and sagacity can enable him to anticipate. But even when he has provided for the usual contingencies of the elements, he has to encounter storms and surges, the effects of which he could neither foresee nor calculate.

In greater peril, perhaps, than the military engineer, who erects his works in the middle of cannonading redoubts, and who sees his men falling around him, his defences broken down, his implements and his materials crushed or dispersed, the engineer of a submarine-founded lighthouse is surrounded on all points by an enemy still nearer him;—an enemy that sometimes undermines his foundations, unscrews his bolts, breaks his iron beams, and whirls his granite blocks into the air, as if Neptune and all his court had stumbled over this pillar of the deep.

The work of which we propose to give here a brief notice, is a large quarto, illustrated with twenty-three engravings. It is ably drawn up by Mr. Stevenson, the engineer of the Bell Rock Lighthouse, and is published under the direction of the Commissioners of the Northern Lighthouses, a body organised in 1786, and to whose labours (which are purely *ex officio*, and without any remuneration whatever) the country is under the greatest obligations.

The sunken reef on which this Pharos has been erected, is about 427 feet long, and 230 broad, and lies about 12 feet under water at the ordinary height of spring tides. The Board of Commissioners, about the year 1800, being desirous of erecting a light-house on this rock, directed Mr. Stevenson, their engineer, to survey it; he reported, that it was quite practicable to construct a stone building on the principles of the Eddystone Lighthouse. Various opinions in the first instance existed regarding the practicability of the undertaking, from the depth of the foundation so far surpassing that of the Eddystone. Captain Brodie of the Royal Navy proposed an erection on iron pillars, and other modes were likewise projected, when the Commissioners consulted the late Mr. Rennie. That eminent engineer coincided in opinion with Mr Stevenson, in favour of a building upon the principles of the Eddystone. An act of Parliament was accordingly applied for, and passed in 1806, which provided for a loan to the Board of L.25,000; and as there were surplus duties to the amount of L.20,000 in the hands of the Commissioners, the work commenced with funds to the amount of L.45,000. The operations began in 1807; a temporary floating light was provided; a work yard for preparing the stones was established at Arbroath; and a temporary beacon house erected on the rock for the accommodation of about 30 workmen. At this period of the undertaking, the labours and dangers of those employed were very great: The lower floor of the beacon house, which was used as a smith's forge and for preparing the mortar, though elevated 25 feet above the rock, was often set adrift by the violence of the sea, and the lime casks, and even the smiths' anvils, whirled among the waves. During the whole of the operations of the first season, Mr. Stevenson remained constantly with the artificers at the rock, and contributed by his example, as well as by his skilful management of the tempers of the workmen, to surmount the difficulties which often threatened to overwhelm them. The dangers of delaying the most difficult operations rendered it necessary that the work should be carried on upon Sunday; and Mr. Stevenson and all the artificers, except a mason or two, who declined to labour more than six days in the week, continued their labours from day to day without intermission. In boring the holes in the rock, the men often wrought knee deep in water. On many occasions the smith was obliged to labour at his forge with his feet in the sea, while his face was scorched with the fire, and buffeted with the smoke and the sparks which the wind scattered in volumes around him.

These individual calamities, however, became more general in the month of September. The sloop Smeaton broke adrift from her moorings; and from the current of the tides, it was impossible that she could return till after the rock was overwhelmed by the sea. Two boats only were now upon the rock, which could not hold more than one-half of the thirty-two workmen, especially in a heavy sea. The drifting of the Smeaton was known only to Mr. Stevenson and the landing-master. The artificers, while either sitting or kneeling at their work, in the foundation pit, did not know their perilous situation, till the rise of the sea drove them from their work, and made them repair to their respective boats for their jackets and stockings. To their astonishment they saw only two boats in place of three. "Not a word," says Mr. Stevenson, "was uttered by any one, but all appeared to be silently calculating the numbers, and looking to each other with evident marks of perplexity depicted in their countenances." In this state of alarm a pilot boat fortunately came to their relief, and after a dreadful passage, in which Mr. Stevenson's face and ears were encrusted with a film of salt, from the sea spray which broke over the bow of the boat, they got all safely on board of the floating light-ship.

In the year 1808 the work proceeded with great activity. The stones were all prepared at Arbroath, and were fixed with trenails of oak wood and joggles of stone, as in the Eddystone Lighthouse. The cranes and implements were prepared; the site of the beacon was excavated, in some places to the depth of five feet, and the foundation stone was laid on the 10th July. In this season *four* courses were completed, which brought the masonry to the height of 5½ feet above the lowest part of the foundation pit.

In 1809 the building advanced with rapidity. When it had attained the height of eight feet, one of the cranes was erected on the top of it, and in the course of the season it rose to the height of about thirty feet above low water mark. On the 19th of June, however, there was a remarkable ground swell, which made a tremendous breach upon the rock. The sea, at the meeting of the waves, was observed to rise in the most beautiful conical jets of about thirty or forty feet in diameter at the base, to the height of ten or fifteen feet above the crane, and some of the last laid stones were partially lifted, in consequence of their not having been fixed by trenails. On the 11th of August another swell of the sea broke one of the legs of the shear crane, an iron bar containing about sixteen square inches of section, which was snapped, on three different occasions, by the force of the waves. In the month of September the building had risen to the height of thirty feet, which completed the solid part of the structure, and concluded the operations of the season.

During the year 1810 this great structure was completed. The masonry had reached its full height of 100 feet in the month of October, and in December the light was advertised to the public for exhibition, on the 1st of February 1811.

Long after the completion of the lighthouse, viz. on the 14th November 1812, the building was struck with a tremendous sea, the effect of which was more alarming than any thing that had been experienced since its erection. The locks upon the doors were heard to rattle, and, what was very singular, the building was not struck by another sea during the whole tide. The alarm was so great that the artificers, and two of the lightkeepers, sprung from the kitchen up to the balcony, imagining for the moment that some vessel must have got upon the rock, and that the report which they heard was the discharge of a gun; but they soon found that their alarm had been occasioned by the sea alone.

The following short table will exhibit to our readers the relative dimensions, &c. of the Eddystone and Bell Rock lighthouses.

	Eddystone.	*Bell Rock.*
Height of rock about	Level with high water mark.	Level with low water mark.
Height of masonry above the rock	70 feet	100
Diameter of the first entire course	26	42
Cubic contents in feet about	13,147	28,530
Expense understood to have been about	£23,000,	ascertained £61,331 : 9 : 2.

The brief notice which we have now given of the leading operations at the Bell Rock will, we hope, induce the reader to peruse the full and interesting details of them which Mr. Stevenson has given in the work before us. Independent of these details, the scientific reader will find very interesting inquiries respecting natural history, hydrography, and general science, with which this work is enriched. In the introduction Mr. Stevenson has given an historical narrative of the institution of the Board of Commissioners, and of the progress made in the erection of the northern lighthouses; and he has inserted in an Appendix various important documents connected with the subject of his work. The plates and letterpress are highly creditable to the several artists. The frontispiece is engraved by Horsburgh, and the general view by Millar.

The light-keepers of this establishment consist of a principal, a principal assistant, and two others, three of whom are always at the rock on duty, while one is absent on leave. Their pay is from fifty to sixty guineas per annum, besides rations of provisions, uniform clothes, and houses provided for their respective families at Arbroath. Between that place and the light-house, it is not a little curious to observe that a communication is occasionally kept up by the flight of carrier pigeons, with *billets* tied round their legs. The commissioners, with proper feelings toward the inmates of this dreary abode, have provided them with a selection of Voyages and Travels, &c.; a weekly newspaper, though, (on account of the tides, it cannot reach them oftener than once a fortnight) and also one of the monthly journals.

IV. *Acta Academiæ Naturæ Curiosorum. Tom. XI. Part* 1.

It may be interesting to our Zoological readers to be informed, that this volume, (which has but lately reached Britain,) contains several zoological papers, to which some very distinguished names are attached; we have not, however, been able to observe any very striking or novel views in these memoirs. Dr. Lehman has described several new species of dipterous insects, which he discovered in the country around Hamburgh; and there is a paper calculated to render more precise our knowledge of the larger cetacea by Dr. de Chamisso, being the drawings of several species of whales taken from wooden figures of these animals fabricated by the inhabitants of the Aleutian Isles. A memoir on the fossil remains of a gigantic ruminating animal, by Bojanus, is followed by another, the production of E. d'Alton, in which the teeth of the Giraffe are carefully examined and described with a direct reference to the essay of Bojanus on the fossil animal which he has called *Erycotherium Sibericum*. Dr. Tilesius has attempted in a short memoir to prove that the *Argalis* of Pallas must be the primitive or wild stock whence the domestic sheep is derived. The opinion of this excellent naturalist is disputed by Bojanus, in an anatomical paper, entitled, "Craniorum Argalidis, Ovis et Capræ Domesticæ Comparatio;" we shall here notice, though very briefly, the objections offered by Bojanus to the opinions of Tilesius.

1. In the sheep, the occiput is much longer and broader than in the argalis; on the other hand, the forehead of this latter is much broader than in the sheep. The face is shortest in the argalis, and the horns do not diverge so rapidly.

2. The tail of the argalis is very short, its habits are wild and savage, and it is clothed with hair instead of wool.

3. It differs from the genus *Capra*, in not possessing the lachrymal lacunæ, but rather resembling the sheep in this part of the osteology of the head. Bojanus concludes from these data, that the argalis belongs to a species distinct from the sheep or goat.

We shall not here stop to argue whether or not the argalis be really the original stock of the domestic sheep; we shall merely remark, that the objections drawn from the slight dissimilarity in the crania of these animals are of little moment:

1. The size and length of the occiput in the domestic sheep, when compared with the argalis, seem to depend on the elongation of the head and face; now, this is owing chiefly, as may be observed in the

horse, to the rankness or strength of the pasture on which the animal feeds, and to the comparative humidity of the climate. The forehead is said to be broader in the argalis than in the sheep, but this may be a deception; it is, however, evident that the orbits are more projecting, and, consequently, that there is a wider range of vision; but this occurs in many varieties of dogs (as the fox terrier,) without our viewing them as distinct species. The extreme vigilance required on the part of the argalis to guard against its numerous enemies, may have necessitated this structure, which, in the domestic sheep has gradually become less distinct. Upon the whole, we are disposed to think Tilesius right in the views he has adopted relative to the argalis, though there is but little which may be called novel in his Memoir.

We shall speak of but two memoirs more contained in this volume: the first of these is by Carus, and is entitled, "Icones Sepiarum in Littore Maris Mediterranei Collectarum;" these engravings are very beautifully executed. He takes notice of the remarkable coloured points visible on the integuments of the cuttle-fish, which contract and dilate alternately, as if possessing a certain degree of pulsation: these contractions and dilatations cease shortly after life becomes extinct. Though these coloured points may possibly have been long ago noticed by many naturalists, it seems to us that they were first described by De Blainville; some time afterwards Carus, and finally Sangiovanni, in the *Giornale Encyclopedia di Napoli, an. xiii. No.* 9. redescribed this system of coloration, and offered explanations of the phenomena any thing but satisfactory. The writer of this notice observed these pulsating points in the skin of the cuttle-fish in 1821, with the same want of success, as to a correct theory of their true nature; the aid of the microscope was not neglected.

The last memoir is one by Rosenthal on the branches which form the *Vena magna galeni,* and on the veins of the brain generally. (K.)

ART. XXIX.—NOTICES OF RECENTLY PUBLISHED PERIODICAL BOTANICAL WORKS.

Botanical Magazine for September, No. 452.

TAB. 2509. *Azalea indica,* var. β. plena, a state of the plant far inferior, in our opinion, to the common one. t. 2510, *Ornithogalum Narbonense,* a native of the South of Europe. t. 2511, *Bellis sylvestris,* an inhabitant of Portugal and Spain. We have received the same plant from our excellent correspondent, Mr. Bentham, from about Montpellier. t. 2512, *Coreopsis tinctoria* of Mr. Nuttall, who found this beautiful and most desirable species in the Arkansa territory. In the Glasgow Botanic Garden we have cultivated it in the open air, where it bears incomparably finer flowers than in the green-house. t. 2513, *Monarda Russelliana,* first mentioned by Mr. Nuttall, and named in honour of his friend, Dr. Russell, in his travels in the Arkansa territory. Raised by Mr. Barclay of Buryhill, as well as by ourselves in the Glasgow garden.

t. 2514, *Euphorbia carinata* of Donn's Hort. Cant. (*E. canaliculata* of Lodd Cab. and *Crepidaria carinata* of Haworth's Succul. Plants, Suppl. p. 67.) This appears to us not to be different from the figure in Dillenius' Hort. Elth. t. 288, the *Pedilanthus tithymaloides*, β. of Poiteau in Ann. du Mus. v. 19. p. 390. t. 19. f. 1. and the *P. tithymaloides* of Kunth, in Humboldt's Nov. Gen. v. 2. p. 63. This is surely a good genus; *Pedilanthus* is the older name, though having the same meaning as Mr. Haworth's *Crepidaria*. t. 2515, *Malva prostata* of Cavanilles, and De Candolle. Introduced by the late Mr. John Walker from Brazil. t. 2516, *Ophrys arachnites* of Linn. and Willd.

Botanical Register for Sept. No. 115.

Tab. 825. *Isochilus prolifer*, a rare and interesting plant, indigenous to the West Indies, the *Epidendrum proliferum* of Swartz. Under this article are some valuable observations on the Exotic Orchidea, by Mr. Lindley. t. 826, *Leucadendron tortum*, Br. t. 827, *Ardisia punctata*, *n. sp.* "foliis lanceolatis coriaceis sinuatis versus basin attenuatis, corolla subcampanulata punctata, lobis obtusis." Sent from China to the Horticultural Society of London, by the late Mr. T. Potts. t. 828, *Canonia capensis*. t. 829, *Rosa moschata, var. nepalensis*, the *R. glandulifera* of Roxb. Fl. ined. t. 830, *Dolichos purpureus*, Willd. t. 831, *Arum crinitum*, Hort. Kew, and Willd, a remarkable plant, with the spatha enormously large, not much unlike the extraordinary *Aristolochia grandiflora*, of which the blossoms are used by the children of South America and the West Indies for bonnets.

No. 116. *October*.

Tab. 832. *Brassia caudata* of Lindley, (*Epidendrum* of Linn. and Malaxis of Willd.) Imported by Lee of Hammersmith from the West Indies. Under the descriptive part of this plant we have an enumeration of the genera of the first section of "Epidendreæ, Ecalcaratæ, polliniis duobus." t. 833, *Nicotiana nana*, n. sp. "2-3-uncialis, foliis lanceolatis pilosis, radicalibus quam flores solitarii longioribus, corolla calyce longiore, laciniis obtusis." A curious dwarf plant, sent to the Horticultural Society of London, by W. Bird, Esq. from the rocky mountains of North America, and stated to be the kind from which the Indians make their best tobacco. t. 834, *Melodium monogynum* of Dr. Carey, "foliis ovali-lanceolatis acuminatis, panicula glaberrima." Introduced from the East Indies by Messrs. Whitley and Brames. t. 835, *Scabiosa graminifolia*, a pretty species, native of the south of Europe. We have gathered it in the north of Italy. t. 836, *Guatteria rufa* of Dunal and De Candolle. Sent by Mr. Potts from China to the Horticultural Society's Garden at Chiswick. t. 837, *Pedilanthus tithymaloides* of Poiteau. t. 838, *Heliophila digitata*, De Candolle. The leaves are represented glabrous, and the flowers large, otherwise it very much resembles the *H. stricta* of the Bot. Mag. t. 2526. t. 839, *Acacia calamifolia* of Sweet in Colv. Cat. "petiolis filiformibus longissimis cernuis, pedunculis solitariis petiolo multoties brevioribus, leguminibus arcuatis articulatis corrugatis."

Hooker's Exotic Flora for September, No. 14.

Tab. 119. *Dendrobium Barringtoniæ,* (Sw. and Br. *Epidendrum* Barringtoniæ, Smith Ic. Pict.) t. 220, a beautiful new species of *Dendrobium,* named *Harrisoniæ,* in honour of Mrs. Harrison of Argsburgh, near Liverpool, who introduced it from Rio de Janeiro: "bulbo ovato unifolio, folio ovato-lanceolato undulato basi attenuato, scapo unifloro, petalis duobus inferioribus dorso unitis apice bidentalis." t. 121, *Braya alpina* of Sternberg, from the gardens both of Edinburgh and Glasgow. t. 122, *Pothos acaulis.* t. 123, *Pleuothallis racemiflora* of Lindley, "caule elongato unifolio, scapo folio oblongo emarginato longiore erecto, floribus racemosis secundis acuminatis tetrapetalis." This is the *Dendrobium racemiflorum* of Swartz; and it was first imported from the West Indies by Messrs. Loddiges.

No. 15. October.

Tab. 124. *Dendrobium pubescens,* n. sp. "bulbo oblongo-ovato, foliis distichis lanceolatis glabris, scapo elongato floribusque laxe spicatis pubescentibus, labello oblongo trilobo petalis tribus exterioribus inferne unitis basi saccatis." A very interesting species, communicated by Mr. Shepherd, who had received it from Dr. Wallich. A native of Calcutta. t. 125, *Convallaria oppositifolia* of Lond. Bot. Cab. a native of Nepaul, whence it was sent to the Glasgow Garden by Dr. Wallich. t. 126, *Trizeuxis falcata,* Lindl. Coll. Bot. from the Liverpool Botanic Garden, whither it had been transmitted from Trinidad by Baron de Schack, M. D. t. 127, *Ornithocephalus gladiatus,* constituting a highly curious and new genus, belonging to the 4th section of Mr. Brown's Orchideæ in Hort. Kew: "Flores resupinati. Labellum subpedicellatum, longe attenuatum. Petala subæqualia, duo superiora demum reflexa. Columna brevis, hinc apice una cum anthera longissime rostrata. Massæ pollinis 4, pedicello valde elongata, basi biglanduloso affixæ." This is a small parasitic plant, with equitant leaves. The very singular elongated process of the upper part of the column, with the corresponding anther case which lies upon it, have suggested the generic appellation. Communicated by the Baron de Schack, to the Glasgow Botanic Garden, where it blossomed in August 1824.

No. 16.—November.

Tab. 128. *Trichilia odorata.* t. 129. *Pleurothallis? coccinea,* which the author has, since the engraving of the plate, ascertained to be the *Rodriguesia lanceolata* of Loddiges, and the *Rodr. secunda* of Humb. and Kunth. t. 130. *Monarda Russelliana* of Nuttall.—No. 131. *Baptisia? nepalensis;* a very handsome plant, raised from Nepaul seeds by Mr. Neill at Canonmills, near Edinburgh. "Foliis ternis breviter petiolatis, foliolis lanceolatis subsericeis, stipulis petiolum subæquantibus ovatis acutis deciduis, germinibus pubescentibus, corollæ alis involutis." After this plate likewise had been engraved, and most of the impressions finished, a fully formed seed vessel was communicated to the author by Mr. Neill; and this led him still more to consider the plant as not belonging to the genus *Baptisia*, but rather to *Thermopsis* of Mr. Brown. Mr. Lindley has been kind enough to inform us, that this is the *Podalyria sericea* of Dr. Wallich's MSS.; *Anagyris indica* of Roxb. MSS.; and probably of the same genus with *Podalyria lupinoides*, from Dahuria; and therefore belonging to the *Thermopsis* of Brown. Still, Mr. Lindley, who has seen ripe fruit of our plant, is inclined to consider it not generically distinct from *Anagyris*. t. 132. *Chrysiphiala pauciflora*.—" Floribus ante folia, perianthus laciniis erecto-patentibus, staminibus subæqualibus, corona brevi tubulosa, dentibus bifidis." Sent to the Horticultural Society from Peru, by James Cowan, Esq.

Loddiges' Botanical Cabinet for September, (No. 89.)

Tab. 881. *Lychnis Suecica*. 882. *Erica flava*. 883. *Orobus coccineus*. 884. *Ribes lacustris*. 885. *Azalea sinensis*. 886. *Primula integrifolia*. 887. *Epidendrum anceps*. 888. *Aquilegia canadensis*. 889. *Asarum canadense*. 890. *Gnidia imbricata*.

No. 90. Tab. 891. *Thalictrum petaloideum*. 892. *Cytisus purpureus* 893. *Erica stellata*. 894. *Nerium coccineum*. 895. *Cypripedium pubescens*. 896. *Dianthus punctatus*. 897. *Lupinus Nootkatensis*. 898. *Monsonia speciosa*. 899. *Erysimum lanceolatum*. 900. *Anemone pratensis*.

No. 91. Tab. 901. *Arnica crenata*. 902. *Erica pendula*. 903. *Justicia coccinea*. 904. *Conanthera bifolia*. 905. *Canna iridiflora*. 906. *Ceropegia Africana*. 907. *Mahernia incisa*. 908. *Rhododendron myrtifolium*. 909. *Acacia calamifolia*. 910. *Pachysandra procumbens*.

Greville's Scottish Cryptogamic Flora.

We have only been hitherto deterred by the narrow limits of our space from noticing *periodically*, the contents of Dr. Greville's *Scottish Cryptogamic Flora*, and not from any insensibility to the value of his work, or to the interest of the subjects which it contains. No branch of the botany of this country required to be more illustrated than the *fungi*, which occupy the greater portion of this publication; and although they are not calculated at once to strike and arrest our attention like so many of the plants in the works mentioned immediately above; yet when these productions come to be attentively examined, and their structure and mode of growth closely studied, we shall be led to conclude, that no tribe of plants is more calculated to display the wisdom and power of the Almighty, than these little individuals. We know that by one naturalist the fungi have been called the *Vermes of the Vegetable Creation*, by another the *depurators* and *scavengers of Nature*; but he who bestowed upon them the latter apparently sordid and opprobrious epithet, has at the same time borne witness to their importance in the scale of creation. " The wisdom of Providence," says Mr. Kirby,* " has not only been attentive to provide against the atmosphere being over-

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* In his account of the genus *Ammophila* in the 4th vol. of the *Linnæan Transactions*, p. 196.

23. The oxides of titanium and iron Mr. Seybert regards as accidental. The chemical formula, according to the method of Berzelius, is given $A^4S + 2G\,A^4$. Among the physical properties of the chrysoberyl from Haddam are quoted a pale green colour, and a specific gravity found in one specimen = 3.508, in another = 3.597. It does not present the opalescence of the varieties from Brazil and Saratoga. It occurs in the well-known mixture of albite, quartz, manganesian garnet, and yellow granular beryl. (Silliman's *Journal*, vol. viii. p. 105.)

24. *Potassium and Sodium.*—Mr. Frederick Butz of Nion (Canton de Vaud) in Switzerland, manufactures potassium and sodium for sale, the price of potassium is L.2 per ounce, that of sodium L.4 per ounce. (Schweigger's *Journal*, x. p. 494.)

III. NATURAL HISTORY.

MINERALOGY.

25. ***Rosélite, a New Mineral Species.***—Form prismatic. Combination observed similar to Plate III. Fig. 35. inclination of a^2 on a^2 over $P = 47° 12'$, of $e^{\frac{4}{3}}$ on $e^{\frac{4}{3}}$ over $P = 45° 0'$, b' on b', over $e^{\frac{4}{3}} = 79° 15°$; b' on b' over $a^2 = 114° 24$; b on b adjacent $= 140° 40'$; edge z on edge $z = 125° 7'$; b on $e^{\frac{4}{3}} = 129° 0'$ *Cleavage* distinct and brilliant parallel to P. *Surface*, a^2 rough, and as it were hollowed out in the middle, the rest smooth. *Colour* deep rose-red. *Translucent*. *Hardness* = 3.0, the same as calcareous spar. It was discovered by Mr. Levy in the collection of Mr. Turner, in small well-defined crystals on amorphous greyish quartz from Schneeberg in Saxony. Mr. Levy remarks that its great resemblance with the arseniate of cobalt from the same locality, had hitherto caused its being placed with it. It is named in honour of that distinguished mineralogist, Mr. Gustavus Rose of Berlin. According to Mr. Children, who examined its chemical properties, it gives off water before the blowpipe in the matrass, and becomes black; with borax and salt of phosphorus in the oxidating flame upon platina wire, it yields an intensely deep blue glass. It gives soluble salts with muriatic acid, which produce a precipitate with oxalate of ammonia. Digested in caustic potash, evaporated, redissolved, and the alkali neutralized with nitric acid, it gave, with nitrate of silver and ammonia, a brown-red precipitate of arseniate of silver; with bicarbonate of ammonia and phosphate of soda, it gave indications of magnesia. It therefore contains water, oxide of cobalt, lime, arsenic acid, and magnesia.

Roselite is a very rare mineral, though from the preceding description it appears that the specimen in Mr. Turner's collection is not the only one described in mineralogical works. There is a specimen of it in the Wernerian Collection at Freiberg, to which the ancient but not very accurate description by Werner of the crystals of cobalt bloom refers, that they are *compressed, acute, double, six-sided pyramids.* (*Jam. Syst.*

November 22.—At a general Meeting of the Society, held this day, the following Office-bearers were elected:—

Sir Walter Scott, Bart., *President.*

Right Hon. Lord Chief Baron,
Lord Glenlee,
Dr. T. C. Hope,
Professor Russell, } *Vice-Presidents.*

Dr. Brewster, *Secretary.*
Thomas Allan, Esq. *Treasurer.*
James Skene, Esq. *Curator of the Museum.*

Physical Class.

Alexander Irvine, Esq. *President.*
John Robison, Esq. *Secretary.*

Counsellors.

Rev. Dr. Macknight,
Robert Stevenson, Esq.
Sir William Arbuthnot, Bart.
James Jardine, Esq.
Sir William Forbes, Bart.
Dr. Home.

Literary Class.

Henry Mackenzie, Esq. *President.*
Peter F. Tytler, Esq. *Secretary.*

Lord Meadowbank.
Professor Wilson.
Sir William Hamilton, Bart.
Rev. Dr. Lee.
The Right Hon. the Lord Advocate.
Henry Jardine, Esq.

December 6th.—At this meeting, there was read by John Cay, Esq. a notice respecting two Ancient Graves, discovered at North Charlton, parish of Ellingham, Northumberland, in January 1823.

At the same meeting, there was read Observations on the Vision of Impressions on the Retina, in reference to certain supposed discoveries respecting Vision, announced by Mr. Charles Bell. This paper forms the first article of the present number.

2. *Proceedings of the Wernerian Natural History Society.*

November 13th.—There was read a notice by Major-General Hardwick, of the Incarceration of a Live Toad in a well at Fort William barracks, Calcutta, for 54 years. The evidence relative to the actual incarceration of the toad, and its total exclusion from the external world, seemed to be quite imperfect.

The preface of a paper by Mr. George Don, was read on the monocotyledonous and acotyledonous plants, found between the 4th and 11th degrees of north latitude on the west coast of Africa.

There was read, an account of a viviparous variety of *Juncus Lampocarpus* by Mr. Parry. It was doubted whether this was a new variety of the plant alluded to, and even whether this was the name of the specimen submitted to the Society. The occurrence of viviparous varieties among similar plants was said to be by no means unusual.

December 5.—There was read notices regarding the Blair Drummond fossil whale, by H. Home Drummond, Esq. and Mr. Blackadder.

The President, R. K. GREVILLE, Esq. requested Dr. Knox to ascertain, as far as the specimens admitted, to what species of the cetacea the bones now presented to the Society belonged; and to give in a notice on that subject at a future meeting.

3. *Proceedings of the Society for promoting the Useful Arts in Scotland.*

December 7th.—There was read, the Description of the first Steam-engine, invented by the Marquis of Worcester.

This paper forms Art. V. of the present number.

The following papers were also laid before the Society, to be read in their order at the next meeting on the 21st of December.

1. Description of the original Machine for Drying Linen by Steam, invented by the late Mr. James Watt. The Drawing and Description by Mr. WATT.

2. Description of the new Fangate Sluice, invented and erected on the Steinenboch Canal by M. BLANKEN of Amsterdam.

3. Description of several new Sluices, by Mr. THOM of Rothsay.

4. Description of an Instrument called a Trigon, for solving Problems in Navigation, by Mr. BURNETT, Dunse.

The following Instruments were exhibited at the Meeting:—

1. Mr. Burnett's Trigon.
2. Files manufactured by M. Raoul of Paris.
3. Specimens of Curves described by Mr. Jopling's Machine.

ART. XXXI.—SCIENTIFIC INTELLIGENCE.

I. NATURAL PHILOSOPHY.

ASTRONOMY.

1. *Elements of the New Comet of* 1824.—This comet was discovered on the 23d of July by M. Scheithauer of Chemnitz; on the 24th July by M. Pons at Marlia; on the 26th July by M. Gambard of Marseilles; and on the 2d August by M. Harding at Gottingen. The following are the elements of its orbit as calculated by M. Capocci, M. Carlini, and M. Encke:

	Capocci at Naples.	Carlini at Milan.	Encke at Seeberg.
	D.	D.	D.
Passage of Perihelion, Sept. 1824	29.0465	28.800	28.847
Log. of Perihelion Dist. -	0.02175	0.02346	0.02392
Long of Node, - -	279° 19′ 30″	279° 31′ 35′	279° 28′ 27′
Long. of Perihelion -	4 24 36	4 25 29	4 2 27
Inclination of Orbit -	54 41 20	55 1 10	55 1 24
Motion direct			

M. Encke seems to have obtained other elements, which establish that the comet has an hyperbolic orbit. The following are those which have appeared:

Passage of Perihelion, Sept.	29 02259
Long. of Perihelion	4° 25′ 57″ 2
Long. of Asc. Node	279 15 31 6
Inclination of Orbit	54 43 7 8
Eccentricity	1,006046

M. Carlini has remarked it as a curious circumstance, that though the distance of the comet from the sun was increasing, the light of the comet was increasing also.

On the 1st of January, 1825, its right ascension will be 75° 8′ its declination 47° 5′ north, the log. of its distance from the sun 0.2618, and the log. of its distance from the earth 9.96207. Zach. *Cor. Astron.* vol. xi. p. 196.—*Phil. Mag.* vol. lxiv. p. 309.

2. *The Buenos Ayres Comet of* 1821.—The observations on the comet which we mentioned in our last number, vol. i. p. 37, as very suspicious, have turned out to be an imposition. M. Encke of Seeberg has been at the trouble to compare the Buenos Ayres observations with Dr. Brinkley's elements of the comet of 1821, observed by Captain Basil Hall, and the result is, that the observations are false. Baron Zach very appropriately remarks, that if the other transactions of that country resemble this, the new republic of Buenos Ayres will soon take the road of the comet.

3. *Spots on the Sun in* 1824.—About the end of May, M. Flaugergues observed on the west limb of the sun a very large spot about to disappear. From that time till near the end of August he had not observed any spots whatever on the sun's disc. M. Pons of Marlia observed a fine spot on the sun on the 26th of May, and surrounded with a penumbra like Saturn's ring. He saw numerous white spots on the sun's disc.

4. *Lohrmann's Maps of the Moon.*—M. Lohrmann, Professor in the Military Academy at Dresden is about to publish an Atlas of Lunar Maps, which will represent the whole surface of the lunar globe with an accuracy and precision beyond any thing that has yet been attempted. Baron Zach has seen the first section of these maps containing a part of the *Mare Nubium*, of the *Mare Vaporum*, and of the spots named Ptolemy, Hipparchus, Albategnius, &c. which he considers as executed with infinite care and accuracy.

5. *La Place on the Masses of the Planets.*—In a new edition of his celebrated work entitled *Exposition du Systeme de Monde,* which has just appeared, he has given the following new measures for the masses of the planets:

	New Masses.		Old Masses.
Georgium Sidus	$\frac{1}{17918}$		$\frac{1}{19504}$
Saturn	$\frac{1}{3512}$		$\frac{1}{3559,4}$
Jupiter	$\frac{1}{1070,5}$		$\frac{1}{1067,06}$
Venus	$\frac{1}{334936}$		$\frac{1}{337086}$
The Earth	$\frac{1}{405871}$		$\frac{1}{356632}$
The Moon	$\frac{1}{75}$	Of that of the Earth in place of	$\frac{1}{68,5}$

6. *Parallax of the Sun.*—That able astronomer M. Encke of Gotha, is about to publish an elaborate work on the Parallax of the Sun, as deduced from the Transit of 1769. The parallax obtained for the transit of 1761 was between 8″.429813 and 8″.551237. The result of M. Encke's computations is 8″.5776. The semidiameter of the sun at his mean distance is 858″.424. From the transit of 1639 he deduces the motion of the node of Venus' orbit, which he finds to be 20″.508. Baron Lindenau's Letter to Baron Zach, in the *Corr. Astron.* vol. x. p. 174.

7. *Copley Medal adjudged to Dr. Brinkley.*—The President and Council of the Royal Society of London have adjudged to that distinguished astronomer the Rev. Dr. Brinkley the Copleyan Medal, for his able observations and papers on the parallax of certain fixed stars.

8. *Opposition of Ceres, Pallas, Juno, and Vesta.*—The following are the times of opposition of the four new planets:

			Anomaly.	Dist. from the Earth.
Vesta, 1825,	Feb. 28.	9^h	91° 1′	1.357
Pallas,	March 13.	7	232 2	2.80
Ceres,	March 14.	9	207 16	1.603
Juno,	June 23.	8	38 16	2.143

According to Mr. Groombridge, Pallas will probably appear like a star of the eighth magnitude. Juno will be too near its aphelion in the inferior part of its orbit to be visible with any illumination of the wires, but its transit may be compared with fixed stars. The following are some of the previous positions of these planets.

		R. Asc.	Decl. N.
Vesta, Feb. 6, 1825, at 12^h	-	11^h 19′ 26″	14° 14
Feb. 15.	-	11 13 40	15 30½
			Dec. S.
Pallas, Feb. 18, 1825, at 12^h	-	11^h 48′ 55″	5° 44′
March 1.	-	11 42 59	1 35
			Decl. N.
Ceres, Feb. 18, 1825, at 12^h	-	12 22 38	15 26
March 1. -	-	12 16 12	16 42
			Decl. S.
Juno, May 31. -	-	18 25 44	4 58
June 10. -	-	18 18 24	4 39

Phil. Mag. vol. lxiv. p. 359.

OPTICS.

9. *Singular Colour of the Sun.*—On the 13th September, 1824, from 2^h P. M. to $5\frac{1}{2}^h$ P. M. the sun exhibited a very extraordinary colour, which we never before observed, and have never seen mentioned by any author. It was of a fine salmon colour, which it preserved for many hours. The sky had a vapoury aspect; but the sun was not surrounded by any halo or penumbra of any kind. The barometer stood at 29.74 inches, and the thermometer at 58½°. The wind was in the west, and was

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The Earth	$\frac{1}{405871}$		$\frac{1}{356632}$
The Moon	$\frac{1}{75}$	Of that of the Earth in place of	$\frac{1}{68,5}$

14. *Variation of the Magnetic Needle on the Coast of Karamania.*—Captain Beaufort has given the following measures of the Variation of the Needle, in his Hydrographical Atlas, on the Coast of Karamania.

	N. Lat.	East. Long.	Variation.
Syra Isle, .	37° 26′ 30″	24° 55′ 0″	14° 0′ W.
Koloyeri Rock,	38 9 33	25 17 0	13 45
Sahib Isle, .	38 39 43	26 28 15	13 0
Sighajik, .	38 11 54	26 44 53	12 45
Kastelorizo, .	36 8 33	29 37 28	11 40
Kakava, .	36 10 47	29 53 55	11 30
Ptolemais, .	36 35 50	31 49 0	10 50
Alaya, .	36 51 51	32 2 24	10 40
Cape Anamour,	36 0 50	32 51 0	10 35

15. *Declination of the Magnetic Needle at Paramatta, New South Wales.*—The following Observations on the Declination of the Magnetic Needle have been made at Paramatta, and communicated by Mr. Rumker to Dr. Olbers.

	Declination.		Declination.
1822, Oct. 23,	8° 43′′50′	1823, Mar. 14,	8° 37′ 12″
1823, Feb. 10,	8 46 47	19,	8 38 38
12,	8 43 0	20,	8 40 7
14,	8 34 0	21,	8 53 40
15,	7 37 50	22,	8 39 50
17.	8 36 0	26,	8 47 32
27,	8 49 10	27,	8 50 33
Mar. 10,	8 51 30	31,	8 43 27

16. *Magnetic Variation and Dip observed in the North Seas, by Captain Sabine.*—The following Measures of the Variations and Dip of the Needle were obtained by Captain Sabine.

	N. Lat.	W. Long.	Variation.	Dip.
Hammerfast . .	70° 40′	23° 45′ E.	11° 26′ W.	77° 15′ N.
Fairhaven	79 50	11 40 E.	25 12 W.	81 11 N.
Drontheim . . .	63 26	10 22 E.	20 40 W.	74 42 N.

17. *Scoresby's Observations on the Dip of the Needle.*

	N. Lat.	W. Long.	Mean Dip.
1823, March 29,	Liverpool.		71° 33′ 0″
June 10, . .	71° 31′ 14″	12° 7′ 15″	78 3 6
July 5, . .	71 38 0	17 37 0	79 0 9

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METEOROLOGY.

18. *Increase in the quantity of Rain.*—M. Flauguergues of Viviers, who has for 47 years carefully observed the quantity of rain that fell, has remarked, by taking periods of ten years, that the quantity of rain is continually increasing, and also the annual number of rainy and cloudy days, not only at Viviers, but throughout the South of France.

considerable. The day threatened rain, but only a few drops fell, though showers were seen farther to the west. After 5^{h} 30′ when the sun disappeared, the whole horizon was covered with an uniform tint of a bluish French grey. In the evening the moon had the same appearance as the sun, and although there were faint clouds about her disc, yet these clouds seemed to be illuminated neither by transmitted nor reflected light. The moon shone with a faint dead light, which made no impression upon any external objects. Late in the evening, when her altitude had increased, a faint penumbral light surrounded her disc.

At 11^{h} P. M. A great storm of wind arose, and continued all night. These phenomena were observed near Melrose in Roxburghshire.

10. *Frauenhofer's Large Achromatic Telescope*—This splendid instrument, which was ordered by the Russian government for the observatory of Dorpat, under the direction of that able astronomer M. Struve, is at last completed; and Frauenhofer is said to have succeeded beyond his most sanguine expectations. Its focal length is 13 feet 4 inches, and the aperture of the object glass is 9 inches Paris measure or 9 inches and 6-10ths English measure.

MAGNETISM.

11. *Oscillations of the needle affected, by being enclosed in a copper case.*—We understand that, at a recent meeting of the Academy of Sciences, M. Arago has shown that the magnetic needle, when disturbed, makes fewer oscillations in coming to rest, when enclosed in a copper case than in one of any other material, whether of metal or wood. *Letter from Paris.*

12. *No diurnal variation of the needle at the Equator.*—M. Arago has, we understand, deduced from M. Duperry's observations on the diurnal variation of the needle, that *there is no diurnal variation at the earth's equator.*

13. *Variation of the Magnetic Needle, observed in Africa in* 1823. Captain Smith observed the Declination of the Needle, in Africa, as follows:

	N. Lat.			East Long.			Variation.	
Mesurata, .	32°	21′	26″	15°	16′	45″	16°	50′ W.
Melhufu, .	31	58	56	15	27	55	16	30
Isa, . .	31	32	50	15	31	46	16	10
Zaphrun, .	31	12	10	16	41	29	16	40
Boosheida, .	30	59	30	17	39	21	16	0
Kadia, .	30	44	13	18	17	50	15	26
Bushaifa, .	30	17	40	19	11	30	15	10
Braijea, .	30	23	29	19	39	30	14	25
Gharra, .	30	47	20	19	57	24	15	0
Corcora, .	31	28	20	20	0	10	15	10
Bengazi, .	32	6	50	20	2	56	14	50
Tholomela, .	32	42	29	20	54	50	14	30
Cape Rasat, .	32	55	56	21	38	54	14	12

Baron Zach's *Corresp. Astron.* tom. viii. p. 535.

23. The oxides of titanium and iron Mr. Seybert regards as accidental. The chemical formula, according to the method of Berzelius, is given $A^4 S + 2G A^4$. Among the physical properties of the chrysoberyl from Haddam are quoted a pale green colour, and a specific gravity found in one specimen = 3.508, in another = 3.597. It does not present the opalescence of the varieties from Brazil and Saratoga. It occurs in the well-known mixture of albite, quartz, manganesian garnet, and yellow granular beryl. (Silliman's *Journal*, vol. viii. p. 105.)

24. *Potassium and Sodium.*—Mr. Frederick Butz of Nion (Canton de Vaud) in Switzerland, manufactures potassium and sodium for sale, the price of potassium is L.2 per ounce, that of sodium L.4 per ounce. (Schweigger's *Journal*, x. p. 494.)

III. NATURAL HISTORY.

MINERALOGY.

25. ***Rosélite, a New Mineral Species.***—Form prismatic. Combination observed similar to Plate III. Fig. 35. inclination of a^2 on a^2 over $P = 47° 12'$, of $e^{\frac{4}{3}}$ on $e^{\frac{4}{3}}$ over $P = 45° 0'$, b' on b', over $e^{\frac{4}{3}} = 79° 15°$; b' on b' over $a^2 = 114° 24$; b on b adjacent $= 140° 40'$; edge z on edge $z = 125° 7'$; b on $e^{\frac{4}{3}} = 129° 0'$ *Cleavage* distinct and brilliant parallel to P. *Surface*, a^2 rough, and as it were hollowed out in the middle, the rest smooth. *Colour* deep rose-red. *Translucent*. *Hardness* = 3.0, the same as calcareous spar. It was discovered by Mr. Levy in the collection of Mr. Turner, in small well-defined crystals on amorphous greyish quartz from Schneeberg in Saxony. Mr. Levy remarks that its great resemblance with the arseniate of cobalt from the same locality, had hitherto caused its being placed with it. It is named in honour of that distinguished mineralogist, Mr. Gustavus Rose of Berlin. According to Mr. Children, who examined its chemical properties, it gives off water before the blowpipe in the matrass, and becomes black; with borax and salt of phosphorus in the oxidating flame upon platina wire, it yields an intensely deep blue glass. It gives soluble salts with muriatic acid, which produce a precipitate with oxalate of ammonia. Digested in caustic potash, evaporated, redissolved, and the alkali neutralized with nitric acid, it gave, with nitrate of silver and ammonia, a brown-red precipitate of arseniate of silver; with bicarbonate of ammonia and phosphate of soda, it gave indications of magnesia. It therefore contains water, oxide of cobalt, lime, arsenic acid, and magnesia.

Roselite is a very rare mineral, though from the preceding description it appears that the specimen in Mr. Turner's collection is not the only one described in mineralogical works. There is a specimen of it in the Wernerian Collection at Freiberg, to which the ancient but not very accurate description by Werner of the crystals of cobalt bloom refers, that they are *compressed, acute, double, six-sided pyramids*. (*Jam. Syst.*

3d edit. Vol. II. p. 193.) They are in fact lenticular, compressed between the faces marked a^2 in the figure, which are somewhat rounded and rough, and contains besides $e^{\frac{4}{3}}$ and g. Upon examining that specimen in comparison with the crystals of arseniate of cobalt, it was clear that it belonged to a different species; the establishment of which, however, is entirely due to Mr. Levy, as it was impossible to detach a crystal from that group for ascertaining its characters without too much injuring the specimen.

26. *Columbite.*—Dr. Torrey of New York has ascertained that Haddam, in Connecticut, is the most likely locality of that variety of Columbite which had been sent to Sir Hans Sloane by Governor Winthrop of Connecticut, and in vain sought for in the vicinity of New London, the locality quoted. Count Trolle Wachtmeister first discovered that there was tantalite in one of the specimens of the Haddam rock, containing cymophane, beryl, &c. sent to him by Dr. Torrey. This was, however, only a very small quantity. Dr. Torrey found lately amorphous masses half an inch in diameter, and smaller crystals, which are very perfect, and engaged in the red garnet, which has been found by Mr. Seybert to contain 30 p. cent. of manganese. These crystals are frequently associated with cymophane, as is the case in a specimen of the latter in Mr. Allan's cabinet. (*Ann. of the Lyceum of Nat. Hist. New York.*)

27 *Brochantite, a New Mineral Substance.*—*Form,* prismatic. Crystallization observed similar to Plate III. Fig. 31. Inclination of a' on $a' = 150° 30'$, of M on M $= 114° 20$, of e^4 on e^4 (adjacent) $= 63° 0'$. Faint indications of *cleavage* in the direction of M. *Surface* of M blackish and dull, the rest of the faces brilliant, and fit for measurement by reflexion. *Colour,* emerald green. *Transparent. Hardness,* about the same as that of green carbonate of copper. It has been described by Mr. Levy, who measured the angles of the crystals by means of the reflective goniometer, and named it in honour of Mr. Brochant at the suggestion of Mr. Heuland. It occurs in very minute crystals on mamillated green carbonate of copper, lying upon massive red copper, from the bank mine, Ekatherinaburgh, Siberia.

According to Mr. Children's experiments, upon a very small quantity, before the blowpipe, it consists chiefly of sulphuric acid, and oxide of copper; but on account of its perfect insolubility in water, he is of opinion that it must contain some other substance beside these, which from some appearances while trying it with salt of phosphorus, might be silica or alumina, or perhaps both. It gives no signs of arsenic, phosphorus, lime, magnesia, manganese or iron, though likewise tried in the humid way.

28. *Fluellite, a New Mineral Substance.*—*Form,* prismatic. Combination observed an acute scalene four-sided pyramid, having its most acute solid angles taken off, Plate III. Fig. 32. Angles = 109°, 82°, 144, (nearly,) the transverse section, therefore, nearly 105°, according to Dr.

Wollaston. *Colour* white. *Transparent.* Index of refraction = 1.47. Mr. Levy had remarked this substance in minute crystals, accompanying the wavellite from Cornwall. Dr. Wollaston examined it at his request, and found it to be a compound of alumina and fluoric acid, in reference to which he suggested the name of Fluellite. His comparative examination of the refractive power of wavellite, gave for the index of the latter 1.52. (*Annals of Philosophy*, Oct. 1824, p. 241.)

29. *Analyses of several native Carbonates of Lime, Magnesia, Iron, and Manganese, by M. P. Berthier.*

No.	Lime.	Magnesia.	Protoxide of Iron.	Protoxide of Manganese.	Clay or Quartz.	Carbonic Acid and Water.
1	50.0	3.9	......	......	5.0	41.1
2	46.8	6.2	......	......	2.8	44.2
3	34.8	17.2	0.5	......	0.6	46.6
4	30.0	21.0	......	......	2.4	46.6
5	21 8	16.0	1.4	......	22.8	36.4
6	53.8	...	2.0	0.7	......	42.9
7	29.0	11.0	11.0	......	6.9	42.1
8	26.6	...	9.0	7.6	22.6	34.6
9	37.4	1.0	5.0	5.0	14 6	37.4
10	35.2	5.6	10.6	4.0	1.4	43.2
11	34.5	6.8	5.6	9.2	......	43.5
12	31.4	7.2	8.3	1.6	2.3	37.7
13	29.7	2.0	8.5	3.5	0.4	44.3
14	28.6	16.2	5.0	2.2	4.8	43.0
15		15.4	42.8	......	......	Carbon. Acid. } 41.8
16		12.2	45.2	0.6	......	40.4
17		2.3	43.0	11 0	5.7	38.0
18	1.7	0.7	50.5	8.0	1.0	38.1
19	11.0	1.2	34.0	3 6	7.0	32.7
20	5.0	2.0	43.6	6.0	9.1	34.3
21	4.0	0.8	51.5	......	8.7	35.0
22	14.0	23.0	......	......	Silex & Water { 25.0	36.0
23	5.4	...	......	56.0	......	38.6
24	5.0	0.8	4.5	51.0	......	38.7

1. Compact dark-gray secondary limestone, from Ardennes.

2. Freshwater limestone, from Quincy, near Mélun. Resembling chalk.

3. Compact yellowish-gray secondary limestone, from Epinac.

4. Dolomite, white, friable, and resembling sugar.

5. Dolomite, from the Alps.

6. Rose-coloured calcareous spar, and with the brown variety analysed, No. 10, from Moutiers in Savoy, where it occurs along with the golden titanium. Cleavable in large rhombohedrons, with faces of composition parallel to R—1. Spec. grav. = 2.71.

7. Compact gray secondary limestone, from the iron works of Rancié, Arriège.

8. Compact gray secondary limestone, forming the roof of the iron ore at la Voulte, Ardèche. Spec. grav. = 2.68.

9. Compact gray, almost earthy limestone from Timor, from the expedition of Captain Baudin. Spec. grav. 2.60. This gray variety is mixed with another which is brown, and becomes brown itself on being calcined.

10. Brown opaque calcareous spar, from Moutiers, cleavable in rhomboidal laminae, occurs with No. 6. Spec. grav. = 2.64. Its colour is owing to an incipient decomposition.

11. Limestone from Devonshire.

12. Calcareous spar, from Notre-Dame-du-Pré, in Savoy. Cleavable, of a violet-blue colour. Spec. grav. = 2.9. This variety seems to contain free oxide of iron, as its carbonic acid is not sufficient for saturating all the bases.

13. Calcareous spar, from Pezey in Savoy. Crystallized in the primitive rhombohedron. White, semi-transparent, of a lustre approaching to pearly. Spec. grav. = 2.94.

Its surface becomes brown on being exposed to the moist atmosphere. It would be interesting to know from the indication of the angles of the rhombohedron, of hardness, &c. joined to that of specific gravity, whether the two last varieties do not belong to some of those species which have lately been separated from the real calcareous spar.

14. Granular yellowish-white, or grayish-white calcareous spar, with a pearly lustre, from Framont, in the department of the Vosges, where it accompanies the hydrate of iron. Analysed by M. de Beaumont.

15. Sparry iron, from Allevard. Cleavable in large laminae, of a pale colour, which are perfectly homogeneous.

16. Sparry iron, from Autun. Cleavable in large laminae, of a pale colour.

17. Small-grained sparry iron, from Allevard, mixed with quartz.

18. Sparry iron, from St. George de Huntières, in Savoy. Small-grained, of a very pale colour.

19. Kidney-shaped clay iron-stone, from la Voulte, Ardèche. Compact, gray in the interior, and red on the outside. Spec. grav. = 3.08, Analysed by M. Lamé.

20. Kidney-shaped clay-iron stone, from Martigues, Bouches-du-Rhône. Compact, earthy, consisting of alternating parallel layers of a yellowish and grayish colour.

21. Compact sparry iron, from Chaillaud, Dep. de la Mayenne. This variety occurs in a mine worked for brown iron-ore, in kidney-shaped masses, called *conillards*, and thrown away by the workmen, as containing no iron. It is red on the outside, but dark gray, nearly black within. The fracture is very fine grained, and conchoidal. Spec. grav. = 3.58. It acts very distinctly upon the magnetic needle. It seems to contain 2.5 per cent of the magnetic oxide of iron. The dark colour of the mineral is owing to bituminous matter.

22. Compact yellowish-gray magnesian limestone, from Elba, of an earthy fracture.

23. Rose-coloured carbonate of manganese, from Nagy-ag. Cleavable and translucent on the edges.

24. A similar variety of the same from Freiberg. (See the *Annales des Mines,* t. xiii. p. 887.)

30. *Torrelite.*—Under this name in honour of Dr. Torrey, the analysis of a mineral by Professor Renwick has been published, which is found in Sussex county, New Jersey, and supposed to be new. It yielded

Silica,	32.60
Peroxide of cerium,	12.32
Protoxide of iron,	21.00
Alumina,	3.68
Lime,	24.08
Water,	3.50
Loss,	2.82
	100.00

31. *Metallic Titanium*—Metallic titanium, first discovered by Dr. Wollaston in the iron slags from Merthyr Tydvil, has lately been found by Dr. Walchner in similar slags from the high furnace of Kanderea in Baden, and appear from the description given to be exactly similar to those which have been found in this country. (Schweigger's *Journal,* xi. p. 80.)

CRYSTALLOGRAPHY.

32. *The Edinburgh Review and Mr. W. Phillips.*—In an able article in the Edinburgh Review on Mineralogical Systems,* well worthy of being perused by those who are bigoted to their own views of that science, the acute author has stated it as a fact, which must "affect the degree of confidence which we can place in crystallographic indications," that, according to Mr. W. Phillips, the differences in the angles of *cleavage planes,* amount *even to fifty minutes of a degree.* In a sharp note in the *Annals of Philosophy,* No. xl. p. 285, Mr. Phillips has shown that the Reviewer had mistaken his meaning, in using the word *cleavage,* as he meant the *natural planes* of the crystals.

This slight oversight being admitted, justice compels us to vindicate the Reviewer (of whom we have no knowledge) from the charge of ignorance too strongly brought against him; and to state with confidence, that the Reviewer's argument is not in the slightest degree affected by this oversight.

Mr. Phillips distinctly states, that "the measurements of the Crystalline forms, and especially of the secondary planes (given in his own work) are not precisely exact," and that "the limit of error is considerably within *one degree*,—that it rarely exceeds 40 minutes, and is frequently confined to a minute or two."*

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* We trust that the author of this article will reconsider the opinion which he has stated on the system of Professor Mohs. Had he studied Mr. Mohs' own work, which has been published in German, and which will soon appear in English, he never could have expressed such an opinion. It is hard, that the labours of such an eminent mineralogist should be judged of from the erroneous accounts of them that have been given by persons who have not even studied his writings.

Now, though it is quite certain that the cleavage planes of calcareous spar, sulphate of barytes, &c. meet at angles differing very little in value in different specimens; yet, as there are *hundreds of crystals* in which the cleavage planes are either not found at all, or are very imperfect, it follows necessarily, that *in general* the forms of crystallized bodies must be deduced from the inclinations of their natural planes. Even if there are 50 crystals in which the cleavage planes meet at angles which do not vary *one second*, the conclusion drawn by the Reviewer from Mr. Phillips's own admission, remains substantially and undeniably true. The variation of more than *eight minutes* produced in the inclination of the faces of carbonate of lime by an increase of temperature from 32° to 212°, must also be considered as affecting our confidence in crystallographic indications, until the law of the variation shall be discovered.

BOTANY.

33. *Bois de Colophane.*—On reading the account given in the first number of our Journal of the laurel oil, Captain Carmichael observes, "it brought to my recollection a tree I had often met with in the woods of Mauritius, and which is there called *Bois de Colophane;* a *Bursera* if I am not mistaken. From the slightest wound in the bark of this tree there issues a copious flow of limpid oil, of a pungent turpentine odour, which soon congeals to the consistence of butter, assuming the colour of camphor. Like camphor also, it burns with a vivid flame, and leaves no residuum." This is probably the *Bursera panniculata* of Lamarck's *Encyclopédie Botanique,* which is a native of the Isle of France, and of which that author says, that an abundant whitish resin flows naturally from the clefts of its bark.

34. *The late Baron de Schack.*—We regret to learn that the Baron de Schack, so well known to botanists and cultivators of plants, died last September, at La Guayra in South America. He was a native of the Austrian dominions, but had long resided in the island of Trinidad, from whence he had, for many years, sent most valuable contributions of plants, both to the Botanical Gardens of Glasgow and of Liverpool, and likewise, we believe, to that of the Horticultural Society of London. He discovered many new plants, particularly among the parasitical *Orchideæ* and the *Tillanasiæ,* some of which are already described, and others will soon appear, that have recently flowered in our stoves. With great difficulty, and after many failures, the Baron de Schack succeeded in transmitting to this country living roots of the *Arracacha,* one plant of which has flowered at Liverpool, by an examination of which we are enabled confidently to state, that it is the *Conium moschatum* of Humboldt.

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* In another place, Mr. P. admits, that "even the minute crystals, which are generally the *most perfect* of all, *rarely agree* in the angles they afford."

35. *C. S. Parker, Esq.*—This gentleman, the son of C. Parker, Esq. Blochairn, near Glasgow, a most zealous naturalist, who studied the principles of botany under the celebrated De Candolle at Geneva, in a late visit which he made to his concerns at Demerara, formed a very large and valuable collection of the plants of Dutch Guiana. Proceeding thence to the West Indian islands, during the last summer he chartered a vessel on his own account, with the view of rendering himself independent of the ordinary but uncertain mode of conveyance in those seas, and had already investigated many of the islands, when an accident occurred, than which none more disheartening can befal a naturalist,—the loss of his vessel, of the crew, and of the whole of his collections. Deeply as we sympathise with our young friend in this destruction of lives, and of a property (the amount of which none perhaps but a botanist, who has himself gathered such treasures, under such a sun, and with so much toil and fatigue, can duly appreciate,) we cordially rejoice with his family in Mr. Parker's own safety. We have been permitted to make the following extract from his letter, dated on board the *Mail Boat, Endeavour, off Antigua*, Sept. 23, 1824.

"When I had the pleasure of last addressing you from the roads of Basseterre, I little foresaw the circumstances of imminent danger in which I was placed, my merciful preservation from which I can only ascribe to the gracious protection of an overruling Providence. I disembarked at Basseterre on the forenoon of the 7th instant, with the intention of ascending the Souffriere, and starting next day for the islands to leeward. The exorbitant anchorage-dues imposed by Admiral Jacob, amounting to thirty-four dollars upon a small vessel in ballast for a single night, decided the captain in lying off and on during the night. The afternoon was rather squally, and we had several heavy showers while ascending the mountain to a cottage where we spent the night. I awoke suddenly about midnight, and found that a tremendous gale was raging, tearing up forest trees by their roots, devastating the plantations, and doing incalculable damage to buildings and crops, particularly among the coffee trees and plantain walks. At dawn of day, when the fury of the storm had in some degree subsided, the devastated landscape presented an aspect truly dismal, while not a sail was to be descried on the agitated ocean. The loss of lives has been very serious, several vessels having parted from their cables, and grounded on the roads of the Santas. Of the crew of one of them, a garda-costa, manned by thirty-two sailors and officers, not an individual survived to tell the tale. Fifteen days have now elapsed, without a syllable of intelligence having reached me respecting the fate of my unfortunate schooner, which I had chartered, and on board of which were many objects invaluable in my estimation. But on these losses, and others which a mere pecuniary investment (heavy, indeed, in amount,) may replace, gratitude for my extraordinary preservation, and regret for the doom which I fear has befallen my companions, forbid me to permit my mind for a moment to dwell."

We have much gratification in being able to state, that of the collections made by Mr. Parker, those formed at Barbadoes, Trinidad, and St.

19. *Saline Impregnation of Rain.*—After a severe storm on the 5th December 1822, Mr. Dalton examined the rain that fell at Manchester, and found that it contained 1 grain of salt, muriate of soda, in 10,000 grains of water; and as sea water contains 1 grain of salt in 25 of water, there must have been 1 grain of sea water in every 400 grains of rain water. This storm was from the S.W. to the W. The S.W. wind comes from the coast of Wales, distant 100 miles, and the W. wind from off Liverpool, distant from 30 to 40 miles. In subsequent storms, Mr. Dalton found that there was 1 grain of salt water in 200 grains of rain water, and that the salt water had been brought mechanically by the wind at least 30 miles.—*Manchester Memoirs*, New Series, vol. iv. p. 330, 370.

II. CHEMISTRY.

20. *Analysis of the Root of the Male Fern.*—As the root of the *Polypodium filex mas* has been almost universally used as a worm medicine, M. Morin has submitted it to a careful analysis. It was found to consist of, 1. Volatile oil; 2. A fat matter, composed of elaine and stearine; 3. The gallic and acetic acids; 4. Uncrystallizable sugar; 5. Tannin; 6. Soap; 7. A gelatinous matter, insoluble in water and in alcohol. It contains also the sub-carbonate, sulphate, and hydro-chlorate of potash, carbonate and phosphate of lime, alumine, silex, and oxide of iron. *Journ. de Pharm.* May 1824, p. 230.

21. *M. Berzelius' Analysis of* 1000 *parts of Carlsbad Water.*

Sulphate of soda,	2.58713	Carbonate of magnesia,	0.17834
Carbonate of soda,	1.26237	Subphosphate of alumina,	0.00032
Chloride of sodium,	1.03852	Carbonate of iron,	0.00362
Carbonate of lime,	0.30860	Carbonate of manganese,	0.00084
Fluate of lime,	0.00320	Silica, - -	0.07515
Phosphate of lime,	0.00022		
Carbonate of strontian,	0.00096		5.45927

22. *Analysis of Chrysoberyl.*—Mr. H. Seybert of Philadelphia has published the following analyses of the Chrysoberyl, 1, from Haddam in Connecticut, and 2, from Brazil, in which hitherto the presence of Glucina had escaped the notice of Klaproth, Thomson, and Arfvedson. The proportions in the third column are those which Mr. Seybert considers as the true mixture of the species, and the fourth contains the oxygen of each substance.

	Haddam.	Brasil.		
Alumina, .	73.60	68.666	75.75	35.38
Glucina, .	15.80	16.000	17.64	5.49
Silica, .	4.00	5·999	6.61	3.2
Protoxide of iron,	3.38	4.733	0.00	
Oxide of titanium,	1.00	2.666	0.00	
Moisture, .	0.40	0.666	0.00	
Total, .	98.18	98.730	100.00	

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42. *New Species of Mammiferous Animal.*—A correspondent informs us, that M. Isidorus St. Hilaire, a young naturalist of great promise, has obtained the honourable notice of the Institute, by adding a new species to the list of mammalia already known. The animal was brought from the Cape by the late M. de la Lande, (a collector employed by the French government to add to the museum of natural history,) and is described as being analogous in some respects to the hyena, and in others to the civet. He has given it the name of *Proteus.* In the following number of this Journal, we shall offer some remarks on this new species, which probably has not hitherto been accurately described by any naturalist, though it is extremely well known to the colonists, and even to occasional travellers in Southern Africa. The name by which the animal is known on the banks of the Great Fish River, has at present escaped our recollection. (K.)

43. *Fossil Elephant discovered between the Rhine and the Saone* —The bones of this elephant were found on the east side of Lyons, in a garden situated on a hill, between the Rhine and the Saone. The bones were found in what the men supposed was virgin earth. M. Bredin found that they were those of the elephant. The humerus was twelve and a half feet long, and nine inches broad at its upper extremity. The tibia was two and a half feet, and two fragments of the scapula were together two feet long. Some bones of an ox were found among the elephant's ones.—*Phil. Mag.* vol. lxiv. p. 316.

44. *Lamantine.*—Two species of this interesting genus have been determined by Cuvier, chiefly from the characters of the bones of the head, viz. *Manatus Americanus* and *M. Senegalensis.* The former inhabits the shores of South America and the West Indies. Dr. Harlan has published some valuable observations on another American species, which approaches so closely in character to the African one, as to give strong indications of their identity. It is found in considerable numbers about the mouths of rivers, near the Capes of East Florida, Lat. 25°, is killed by the Indians with harpoons during the summer months, and measures from eight to ten feet in length. Dr. Harlan, considering that the snout of the Florida species is wider below the eyes than the African one, proposes to denominate it *M. Latirostris*, but as yet no better marked specific difference has been ascertained. *Journ. Acad. Nat. Sc. Philadelphia*, vol. iii. 390. (F.)

45. *Anas Rufitorques.*—This species of duck, belonging to the genus Nyroca, has been lately established by Mr. Charles Bonaparte. *Journ. Acad. Phil.* iii. 381. It was figured by Wilson in his *American Ornithology*, vol. viii. p.60. *Tab.* 67. f. 5. a: the *Anas Fuligula* of European authors. It differs, however, in the bill having two white bands, neck with a glossy chesnut band, flanks with dusky zig-zag lines, and the speculum ash-grey. Inhabits the North American rivers, as a winter visitant. It feeds on vegetables, and its flesh is tender. Its summer residence and breeding-place is unknown. (F.)

46. *Loligo Brevipinna.*—"Sac short, thick, cylindric anteriorly; subcompressed, obtuse, and rounded posteriorly; fins narrow, rounded, distant." This species has been described and figured by M. C. A. Lesueur. *Journ. Acad. Phil.* iii. 282. *Tab.* 10. It was taken in Delaware Bay. It makes a nearer approach to the L. Sepiola, in the form of the body and the position of the fins, than to any of the other species. The acute author of this description states, in opposition to Blainville, that the sepiola occurs in the British Channel, he having caught one in the Port of Havre in 1814. Pennant's specimen was taken off Flintshire, and there is one, now before us, from the Frith of Forth. (F.)

47. *Lernæa.*—M. Lesueur has published in *Journ. Acad. Phil.* iii. 286. descriptions and figures of three new species belonging to this Linnæan genus. Two of these, *cruciata* and *radiata*, may be included in the genus Lerneocera of Blainville, provided this genus were modified to include, in a section, species with simple arms. If those with simple arms be excluded, our author proposes a new genus for their reception, viz. *Lernecenicus*, "body elongated, attenuated before, and dilated behind; head furnished with many simple subcorneous arms radiating around the mouth." The third species belongs to the genus Lerneopenna of Blainville, and is termed L. Blainvillii. (F.)

48. *Batrachoides.*—This genus was instituted by Lacepede, and is represented by the Gadus Tau of Bloch. Ich. Tab. 67. f. 2. M. Lesueur has recently added two species; viz. *B. Variegata* from Egg harbour, New Jersey, and *B. Diemensis*, from the coast of Van Diemen's Land. *Journ, Acad. Phil.* iii. 395. Both these species belonged to the section having cirri. This group of fishes seems nearly connected with the Lophius of Linnæus, from which, however, it differs in the greater hardness of the skeleton, and in the pectorals being destitute of those footstalks, representing the radius and ulna. (F.)

49. *Sword-fish.*—A specimen of the Ziphias gladius was found on a sand-bank in the Tay, in the end of August, and sent to Dr. Fleming of Flisk. It was upwards of six feet in length, exclusive of the snout or sword, which was two feet and a half. It had been long dead, and was much mutilated, and putrid. On the bronchiæ one specimen of the *Tristoma Coccineum* of Cuvier occurred. The stomach contained numerous remains of the *Loligo sagittata*, which seems its ordinary food, along with the following intestinal inmates, *Ascarus incurva, Tetrarhynchus attenuatus*, and *Bothriocephalus plicatus*, of Rudolphi. (F.)

IV. GENERAL SCIENCE.

50. *Natural Ice-houses near Salisbury, North America.*—Chasms of considerable extent are met with in the mica slate, (Lat. about 43° N.) forming natural icehouses, where the ice and snow remain most of the year. One of these, in the east part of the town, is perhaps worthy of a particular

notice. The chasm is several hundred feet long, sixty feet deep, and about forty in width. The slate is of a very compact kind, and must have required a powerful convulsion to have separated it. The walls are perpendicular, and correspond with much exactness. At the bottom there is a spring of cold water, and a cave of some extent. As you enter the chasm, you are struck with the romantic beauty of the spot. Above, it is completely over-reached with lofty pines (*Pinus strobus*) and hemlock (*P. canadesis*), together with stately walnuts, (*Juglans porcina*) and butter-nuts, (*Juglans cinerea*) &c. &c. while below, the ground is adorned with a great variety of plants, and the rocks with numerous species of mosses, lichens, and ferns. These, together with its coolness and entire solitude, make it a very pleasant retreat in summer. It is called Wolf Hollow, from its formerly being a famous haunt for wolves. Professor Sillman's *Journal*, vol. viii. p. 254.

51. *Dr. Matthew Baillie's Works.*—We are glad to learn, that a complete edition of the works of the late Dr. Matthew Baillie, with an account of his life, drawn up from the most authentic sources, will speedily be published by our eminent countryman Mr. Wardrop.

ART. XXXII.—LIST OF PATENTS FOR NEW INVENTIONS, SEALED IN ENGLAND SINCE JUNE 15, 1814.

June 15. For an Improved *Gas Smoke Consumer.* To W. BAILEY, Staffordshire.

June 22. For Improved *Gas Apparatus.* To JOHN HOBBINS, Walsall.

June 22. For Improved *Carving Knife, and other Edged Tools.* To J. B. HIGGIN, London.

June 22 For Improved *Shearing Machines.* To H. AUSTIN, Gloucestershire.

June 29. For Improvements in *Propelling Vessels.* To W. BUSK, London.

July 1. For Improvements in *Adjusting the Pressure of Fluids in Pipes and Measuring the Fluids.* To W. PONTIFEX, Jun. London.

July 3. For a Method of *Twisting, Spinning, or Throwing Silk, Cotton,* &c. To J. L. BRADBURY, Manchester.

July 3. For Improvements on *Steam Engines.* To PHILIP TAYLOR, London.

July 7. For Improvements on *Masts, Yards, and Ships Tackle.* To J. L. HIGGINS, London.

July 7. For Improved Machinery for *Raising and Dressing Cloth.* To W. HART, and J. WOOD, Leeds.

July 7. For a New Method of *Weaving Woollen Cloth.* To J. C. DANIELL, Stoke.

July 13. For Improvements on *Tillers and Steering Wheels of Vessels.* To C. PHILLIPS, Kent.

July 27. For Improvements on *Fire Arms.* To Charles Random, Baron de Berenger, Middlesex.

July 27. For a process of *Manufacturing certain materials into coarse Paper or Felt.* To Alexander Nesbitt, London.

Art. XXXIII.—LIST OF PATENTS GRANTED IN SCOTLAND SINCE AUGUST 13, 1824.

15. For an Improved *Umbrella.* To Joseph Foot, Middlesex. Sealed 1st September.

16. For a *Hat* on a new Construction. To Robert Lloyd, London. Sealed August 30.

17. For a new Apparatus for *giving Tension to the Warp in Looms.* To W. H. Horrocks, Stockport. Sealed 31st August.

18. For Improved Machinery for *Cleaning and Spinning Cotton and Wool.* To J. G. Bodmer, Manchester. Sealed 21st September.

19. For a new Mode of *Twisting, Spinning, &c. Cotton, Wool, or other Threads,* &c. To J. L. Bradbury, Manchester. Sealed 23d September.

20. For a Method of *Manufacturing Salt.* To Joseph Parkes, Manchester. Sealed 25th September.

21. For Improved Methods of *Preparing and Manufacturing Silk.* To John Heathcoat, Tiverton. Sealed 29th September.

22. For Improved Machinery for *Dressing and Spinning Flax, Wool, Silk,* &c. To Philip Hill, Kensington. Sealed 25th October.

23. For Improved Methods of *Manufacturing and Purifying Gas by the Admixture of Atmospheric Air.* To Simeon Broadmeadows, Abergavenny. Sealed 29th October.

24. For Improvements on *Power Looms.* To James Tetlow, Manchester. Sealed 29th October.

25. For Improved Machinery for *Washing and Whitening Cotton, Linen,* &c. To Junius Smith, London. Sealed November 6th.

26. For Improvements in Masting Vessels. To Richard Guppy, Bristol. Sealed 6th November.

27. For an Improved *Steam Engine.* To Samuel Hall, Basford. Sealed 6th November.

28. For a new *Filter.* To Herman Schrader, Hackney. Sealed 30th November.

29. For Improved Machinery for *Making Cord or Platt,* &c. To John Head, Banbury.

Art. XXXIV.—CELESTIAL PHENOMENA,

From January 1, to April 1, 1824, calculated for the Meridian of Edinburgh. By Mr. George Innes, Aberdeen.

These calculations are made for Astronomical time, the day beginning at noon. The Conjunctions of the Moon and Stars are given in Right Ascension.

JANUARY.

D.	H.	M.	S.	
1	7	56	46	Im. IV. Sat. ♃
1	8	4	16	Im. I. Sat. ♃
1	9	26	—	☌ ☽ ♄
1	12	26	39	Em. IV. Sat. ♃
3	12	51	30	☌ ☽ η II
3	16	0	30	☌ ☽ μ II.
4	8	15	15	☌ ☽ ♑ II.
4	11	31	50	○ Full Moon.
4	12	23	11	Im. III. Sat. ♃
4	15	55	20	Em. III. Sat. ♃
6	0	53	9	☌ ☉ ♅
6	6	59	30	☌ ☽ ♃
6	12	34	32	Im. II. Sat. ♃
6	15	29	24	Im. I. Sat. ♃
8	9	57	48	Im. I. Sat. ♃
11	3	48	38	☾ Last Quarter.
11	16	21	48	Im. II. Sat. ♃
13	15	11	0	Im. II. Sat. ♃
13	17	23	0	Im. I. Sat. ♃
15	11	14	46	☌ ☾ β Oph.
15	11	51	27	Im. I. Sat. ♃
16	8	9	—	Inf. ☌ ☉ ☿
17	3	20	34	☌ ☽ ι ν ♐
17	6	19	51	Im. I. Sat. ♃
17	8	6	12	☌ ☽ ο ♐
17	15	47	10	☌ ☽ ♅
18	6	17	43	☌ ☽ ☿
18	6	28	57	Em. IV. Sat. ♃
18	15	41	49	● New Moon.
19	18	24	36	☉ enters ♒
20	17	47	40	Em. II. Sat. ♃
21	9	24	8	☌ ☽ ♂
22	10	40	10	☌ ☽ ♀
22	13	45	11	Im. I. Sat. ♃
24	7	6	37	Im. II. Sat. ♃
24	8	13	38	Im. I. Sat. ♃
26	20	24	40	☽ First Quarter.
28	7	12	—	☍ ☉ ♃
29	17	54	10	Em. I. Sat. ♃
30	23	35	2	☌ ☽ η II.
31	2	46	2	☌ ☽ μ II.
31	12	22	38	Em. I. Sat. ♃
31	12	36	25	Em. II. Sat. ♃
31	19	6	45	☌ ☽ ζ II.

FEBRUARY.

D	H.	M.	S.	
2	6	51	9	Em. I. Sat. ♃
2	7	49	14	Em. III. Sat ♃
2	12	45	25	☌ ☽ ♃
2	23	16	32	○ Full Moon.
7	14	16	41	Em. I. Sat. ♃
7	15	13	33	Em. II. Sat. ♃
9	8	15	9	Im. III. Sat. ♃
9	8	45	12	Em. I. Sat. ♃
9	11	47	59	Em. III. Sat. ♃
9	13	57	40	☾ Last Quarter.
10				☿ Greatest Elong.
11	16	43	15	☌ ☽ δ Oph.
13	9	13	0	☌ ☽ ι ν ♐
13	14	2	10	☌ ☽ ο ♐
14	0	43	—	☌ ☽ ♅
14	16	10	52	Em. I. Sat. ♃
15	2	56	34	☌ ☽ ♀
16	10	39	24	Em. I. Sat. ♃
16	12	14	34	Im. III. Sat. ♃
16	15	47	31	Em. III. Sat. ♃
17	10	6	43	● Full Moon.
18	3	2	20	♀ near ι ♓
18	7	8	50	Em. II. Sat. ♃
18	9	8	24	☉ enters ♓
19	13	23	—	☌ ☽ ♂
20	13	57	36	Im. IV. Sat. ♃
21	14	42	30	☌ ☽ ♀
23	12	33	43	Em. I. Sat. ♃
23	16	13	36	Im. III. Sat. ♃
25	2	18	20	☌ ☽ A ♉
25	2	42	40	☌ ☾ ♄
25	7	2	20	Em. I. Sat. ♃
25	9	46	8	Em. II. Sat. ♃
25	13	42	31	☽ First Quarter.
27	9	17	35	☌ ☽ η II.
27	12	35	0	☌ ☽ μ II.
28	5	26	0	☌ ☽ ζ II.

MARCH.

1	19	0	20	☌ ☾ ♃
2	14	28	9	Em. I. Sat. ♃
4	8	56	47	Em. I. Sat. ♃
4	9	20	46	○ Full Moon.
4	12	23	29	Em. II. Sat. ♃

D.	H.	M.	S.	
8				♀ Greatest Elong.
9	8	57	55	Im. IV. Sat. ♃
9	12	38	26	Em. IV. Sat. ♃
11	2	23	22	☾ Last Quarter.
11	10	51	21	Em. I. Sat. ♃
11	15	0	52	Em. II. Sat. ♃
12	14	58	3	☌ ☽ ♐
12	19	46	23	☌ ☽ ο ♐
13	8	40	16	☌ ♅
17	7	44	6	Em. III. Sat. ♃
18	10	41	40	☌ ☽ ☿
18	12	46	1	Em. I. Sat. ♃
19	4	17	20	● New Moon.
20	7	14	41	Em. I. Sat. ♃
20	9	13	31	☉ enters ♈
20	16	25	53	☌ ☽ ♂
22	6	57	23	Em. II. Sat. ♃
23	7	5	30	☌ ☽ ♀
24	8	10	1	Im. III. Sat. ♃
24	8	24	24	☌ ☽ A ♉
24	11	43	17	Em. III. Sat. ♃
24	12	31	7	☌ ☽ ♄
25	14	40	40	Em. I. Sat. ♃
26	16	43	12	☌ ☽ η II.
26	18	56	—	Sup. ☌ ☉ ☿
26	20	7	0	☌ ☽ μ II.
27	3	12	35	☽ First Quarter.
27	9	9	27	Em. I. Sat. ♃
27	13	32	3	☌ ☽ ζ II.
29	2	11	17	☌ ☽ ♃
29	9	34	41	Em. II. Sat. ♃
31	12	9	22	Im. II. Sat. ♃

Times of the Planets passing the Meridian.

JANUARY.

	Mercury.		Venus.		Mars.		Jupiter.		Saturn.		Georgian.	
D.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
1.	1	27	2	44	2	30	14	12	9	15	0	24
5.	1	22	2	47	2	27	13	55	8	59	0	8
10.	1	0	2	59	2	23	13	33	8	38	23	47
15.	0	20	2	53	2	18	13	11	8	18	23	29
20.	23	28	2	56	2	13	12	49	7	57	23	10
25.	22	54	2	58	2	9	12	27	7	38	22	51

FEBRUARY.

	Mercury.		Venus.		Mars.		Jupiter.		Saturn.		Georgian.	
D.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
1.	22	32	2	59	2	2	11	55	7	10	22	28
5.	22	29	3	0	1	57	11	37	6	54	22	11
10.	22	30	3	0	1	52	11	15	6	35	21	53
15.	23	35	3	0	1	47	10	52	6	15	21	35
20.	22	43	3	1	1	41	10	27	5	56	21	17
25	22	52	3	0	1	35	10	9	5	37	21	0

MARCH.

	Mercury.		Venus.		Mars.		Jupiter.		Saturn.		Georgian.	
D.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
1.	23	0	2	59	1	32	9	51	5	23	20	42
5.	23	10	2	59	1	27	9	35	5	8	20	26
10.	23	22	3	0	1	21	9	14	4	49	20	11
15.	23	35	2	58	1	15	8	53	4	31	19	50
20.	23	50	2	57	1	9	8	33	4	13	19	30
25.	0	2	2	53	1	3	8	12	3	55	19	10

ART. XXXV.—REGISTER OF THE BAROMETER, THERMOMETER, AND RAIN-GAGE, *kept at Canaan Cottage*. By ALEX. ADIE, Esq. F.R.S. Edin.

The Observations contained in the following Register were made at Canaan Cottage, the residence of Mr. Adie, by means of very nice instruments, constructed by himself. Canaan Cottage is situated about 1½ mile to the south of Edinburgh Castle, about 3 miles from the sea at Leith, and about ¼ of a mile N. of the west end of Blackford Hill. The ridge of Braid Hills is about 1 mile to the south, and the Pentland Hills about 4 miles to the west of south. The height of the thermometer is about 260 feet above the level of the sea. The morning and evening observations were made about 10 A.M. and 10 P.M.

SEPTEMBER 1824.

D. of Week.	Day of Month.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.	
W.	1	57	65	61	51	69	60	29.72	29.77	
T.	2	73	65	69	59	85	72	29.83	29.78	.04
F.	3	69	60	64.5	60	75	67.5	29.83	29.72	
S.	4	62	56	59	52	75	63.5	29.60	29.48	.05
S.	5	58	53	55.5	49	64	56.5	29.37	29.37	
M.	6	52	53	52.5	46	64	55	29.16	29.11	.28
T.	7	60	54	57	49	67	58	29.20	29.30	.24
W.	8	52	49	50.5	45	55	50	29.42	29.44	.05
T.	9	52	44	48	45	62	53.5	29.40	29.54	
F.	10	56	52	54	35	64	49.5	29.61	29.51	
S.	11	60	56	58	50	68	59	29.37	29.23	
S.	12	59	52	55.5	46	64	55	29.32	29.45	
M.	13	60	55	57.5	47	66	56.5	29.69	29.66	.02
T.	14	60	53	56.5	53	67	60	29.51	29.66	.04
W.	15	60	53	56.5	50	67	58.5	29.75	29.87	
T.	16	63	58	60.5	48	69	58.5	29.98	30.02	
F.	17	64	54	59	47	70	58.5	29.98	29.94	
S.	18	67	59	63	48	72	60	29.87	29.81	
S.	19	54	50	52	50	64	57	29.83	29.78	
M.	20	53	52	52.5	41	58	49.5	29.75	29.72	.38
T.	21	52	54	53	50	55	52.5	29.85	30.03	.23
W.	22	57	53	55	52	61	56.5	30.14	30.14	
T.	23	53	50	51.5	49	59	54	30.06	30.06	
F.	24	52	52	52	49	57	53	30.08	29.91	
S.	25	54	41	47.5	47	57	52	29.85	29.94	.05
S.	26	45	37	41	35	49	42	29.82	29.48	
M.	27	42	32	37	31	49	40	29.34	29.41	.14
T.	28	44	33	38.5	29	49	39	29.55	29.63	.05
W	29	41	49	45	28	43	35.5	29.53	29.36	
T.	30	55	60	57.5	44	65	54.5	29.25	28.92	.09
	Sum,	1686	1554	1620	1385	1889	1637	889.66	889.24	1.62
	Mean,	56.2	51.8	54	46.17	62.97	54.57	29.655	29.641	

OCTOBER 1824.

D. of Week.	D. of Mon.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.	
F.	1	58	48	53	50	62	56	28.98	28.88	.20
S.	2	53	49	51	39	58	48.5	28.86	29.04	.03
S.	3	55	53	54	46	60	53	29.25	29.48	
M.	4	56	53	54.5	49	58	53.5	29.63	29.57	.09
T.	5	52	52	52	41	56	48.5	29.50	29.41	
W.	6	52	52	52	50	55	52.5	29.35	29.29	
T.	7	53	53	53	51	54	52.5	29.17	29.12	.77
F.	8	54	53	53.5	52	55	53.5	29.17	29.27	2.03
S.	9	44	40	42	44	49	46.5	29.48	29.57	
S.	10	44	44	44	32	46	39	29.42	29.15	.43
M.	11	42	43	42.5	41	46	43.5	29.17	29.23	.04
T.	12	40	35	37.5	36	45	40.5	29.26	29.23	.20
W.	13	36	39	37.5	27	43	35	29.11	29.23	.07
T.	14	44	33	38.5	38	47	42.5	29.45	29.51	.40
F.	15	40	32	36	20	47	33.5	29.55	29.66	
S.	16	39	33	36	26	44	35	29.68	29.75	
S.	17	37	39	38	37	44	35.5	29.83	29.76	
M.	18	43	48	45.5	32	50	41	29.74	29.66	
T.	19	50	48	49	43	54	48.5	29.60	29.48	.10
W.	20	50	44	47	42	54	48	29.62	29.74	
T.	21	50	50	50	41	56	48.5	29.72	29.67	
F.	22	57	54	55.5	46	61	53.5	29.51	29.51	.25
S.	23	57	50	53.5	50	59	54.5	29.63	29.75	.04
S.	24	52	54	53	44	56	50	29.64	29.33	
M.	25	57	51	54	50	60	55	29.12	29.07	
T.	26	49	45	47	45	52	48.5	28.85	28.80	.08
W.	27	47	40	43.5	43	50	46.5	28.96	29.23	
T.	28	44	35	39.5	34	46	40	29.37	29.51	
F.	29	38	35	36.5	28	43	35.5	29.48	29.43	
S.	30	39	36	37.5	30	47	38.5	29.67	26.90	
S.	31	49	43	46	32	51	41.5	29.43	29.38	
		1481	1384	1432.5	1229	1608	1418.5	911.17	911.61	4.73
		47.77	44.65	46.21	39.65	51.87	45.76	29.393	29.407	

NOVEMBER 1824.

D. of Week.	D. of Mon.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.	
M	1	45	46	45.5	40	46	43	29.34	29.35	.14
T.	2	45	41	43	40	56	48	29.13	29.25	
W.	3	42	35	38.5	36	51	43.5	29.34	29.32	.13
T.	4	37	34	35.5	31	41	36	29.35	29.41	
F.	5	37	32	34.5	31	41	36	29.52	29.68	
S.	6	37	40	38.5	26	44	35	29.82	29.50	.25
S.	7	52	46	49	40	57	48.5	29.42	29.31	.42
M.	8	45	41	43	38	51	44.5	29.27	29.34	
T.	9	43	47	45	37	51	44	29.50	29.30	.21
W.	10	49	41	45	36	51	43.5	29.22	29.39	.30
T.	11	46	40	43	37	48	42.5	29.40	29.44	.07
F.	12	39	39	39	35	42	38.5	29.50	29.67	
S.	13	47	45	46	31	54	42.5	29.40	28.78	.33
S.	14	44	35	39.5	42	55	48.5	28.89	29.29	
M.	15	36	32	34	29	40	34.5	29.55	29.87	
T.	16	45	54	49.5	28	53	40.5	29.40	29.08	
W.	17	53	47	50	48	55	51.5	28.93	28.83	.28
T.	18	37	37	37	32	45	38.5	28.76	29.32	.56
F.	19	42	35	38.5	32	44	38	29.38	29.43	
S.	20	36	41	38.5	31	41	36	29.36	29.00	
S.	21	42	37	39.5	35	47	41	29.02	29.01	
M.	22	38	33	35.5	32	41	36.5	28.92	28.88	.89
T.	23	43	46	44.5	29	46	37.5	28.43	28.26	.24
W.	24	45	42	43.5	43	46	44.5	28.56	28.91	.22
T.	25	41	36	38.5	38	43	40.5	29.15	29.41	
F.	26	37	37	37	33	40	36.5	29.55	29.58	
S.	27	35	34	34.5	33	39	36	29.63	29.46	.20
S.	28	35	40	37.5	32	51	41.5	29.01	28.80	
M.	29	40	32	36	38	48	43	28.35	29.02	
T.	30	34	32	33	27	37	32	29.05	28.85	.14
		1247	1177	1212	104	1404	1222	877.15	876.74	4.38
		41.57	39.23	40.4	34.67	46.8	40.73	29.238	29 .	

THE

EDINBURGH

JOURNAL OF SCIENCE.

Art. I.—*On the Mechanical Effects produced when a Conducting Liquid is electrified in contact with Mercury.* In a Letter from J. F. W. Herschel, Esq. Sec. R. S. Lond. F. R. S. Edin. &c. &c. to Dr Brewster.

Dear Sir,

As I think it the duty of every contributor to science to do all possible justice to his predecessors, as far as their labours become known to him, I beg leave to call the attention of your readers to an interesting paper by Professor Erman of Berlin, published by Gilbert in his *Annalen der Physik*, vol. xxxii. p. 261—292, 1809, entitled, *Wahrnehmung uber das gleichseitige entstehen von mechanischen Cohärenz und chemischen Verwandschaften*, or " Notice of the simultaneous Production of Mechanical Cohesion and Chemical Affinities;" a title from which no one certainly could divine any analogy between the phenomena intended to be treated of by the learned professor and those described in my Bakerian Lecture, *On the Motions produced in Fluid Conductors when transmitting the Electric Current.* This paper, however, I find has been referred to as anticipating my experiments *in toto ;* and I therefore owe it to myself, as well as to its author, to enter into some little examination of its contents ;—premising, that, at the time of publishing my experiments, I was totally ignorant that the subject had ever been investigated either by Professor Erman or by any other.

The paper in question purports to be an extract from a treatise read in 1808 to the Academy of Berlin, containing his principal results, which, digested by him into aphoristical propositions, (in aphoristischen Sätzen,) run as follows:

1. So soon as chemical affinities are excited in galvanic processes, there takes place at the same time an increased intensity of cohesive attraction, (*Flächen-anziehung*,—literally, the attraction of surfaces.)

2. That the connexion which has been supposed to exist between cohesion and chemical affinity receives from this a notable confirmation.

3. That the increase of cohesive attraction arising from electricity, between bodies which act chemically on each other, is altogether different from any electrical attraction of bodies hitherto observed.

4. There is ground to suspect, that, in the galvanic process, attractions at a sensible distance operate in conjunction with that of cohesion (Flächen-anziehung.)

5. Increased attraction of cohesion, and exalted mutual attraction of the ultimate molecules, which arise in quite determinate polarising points, (die in ganz bestimmten polarisirenden punkten entstehen,) are the immediate physical product. The chemical product is dependent thereon by the universal bond which connects adhesion with chemical affinity.

These results he considers as proved by the facts announced in this paper, so far as cohesive attraction is concerned. As to the attraction at sensible distances, he regards it as still problematical.

Professor Erman's results, thus aphoristically stated, especially the 5th, possess certainly in perfection one distinguishing quality of aphorisms—obscurity; but, putting the best interpretation on them they will bear, it is still difficult to imagine what connexion they can possibly have with the phenomena described by me. But this difficulty is cleared up on reading farther, when it appears that these general deductions are totally unsupported by the facts described. The phenomena themselves, however, disencumbered of the aphorisms, are interesting and important, and are, indeed, *as far as they go*, the same with some of those detailed in my paper, or immediate and necessary consequences of the physical law there established.

In the professor's first experiment, a plate of iron, suspended horizontally to one arm of a balance, was brought in contact with water, and its adhesion just balanced by weights in a scale attached to the other arm. The water being connected with one pole of a galvanic pile, and the plate and balance with the other, the equilibrium remained undisturbed. But when the plate was placed in contact with a thin stratum of water covering mercury, on connecting one pole with the mercury, and the other as before with the balance, the equilibrium was immediately destroyed, and the plate descended with a jerk. This effect he attributed to increased cohesive attraction, but its true cause must be looked for in the sudden displacement of the water by the radiating currents produced in the mercury—in the manner described in my paper, the rush downwards from the plate to supply the void, the set of the surrounding liquid inwards, and the pressure of the atmosphere, which forces down the plate into the vacuum left unsupplied from the sources just enumerated.

Another experiment described by Professor Erman is as follows: A globule of water dropped on the surface of a flat dish of mercury is brought into connexion with the positive pole, while the mercury is connected with the negative. It instantly flattens, and spreads to twice its diameter, regaining its former sphericity when the circuit is broken. On this he remarks, that "the same act which has imparted to the quicksilver a decomposing affinity for the water, has at the same time, or previously, effected an increased cohesive attraction between these two fluids." In this view of the case, the extension of the drop on the quicksilver is purely a *statical* result, the molecules assuming their position of equilibrium under the new circumstances of capillary action in which they are placed. In my paper, the same phenomenon is described, and is attributed, if I mistake not, to its true *immediate* cause, viz. a radiation of the superficial molecules of the mercury in all directions from the points nearest the positive pole as a centre, dragging with them the fluid particles adjacent, and thus diffusing them over a larger surface. In this view, the effect is one purely *dynamical.* It is wonderful that Professor Erman should not have apprehended this distinction, and the fallacy of his explanation, as he has noticed the very violent circulation which takes place in the drop—a circulation totally incompatible with the state of statical equilibrium his theory supposes. Yet, so satisfied does he rest of the truth of his explanation, that, having found the same extension of the drop not to take place on a *solid* metal, he observes, that, "*therefore*, the curvature of the two surfaces, *mutually altered by their increased attraction of cohesion*, is the fundamental principle of the phenomenon, whence all the remaining detail flows."

Mr Erman then describes an experiment in which mercury and water being introduced into a capillary tube, and electrified, the column of mercury advanced by starts towards the negative pole. This motion he regards as, indeed, capable of rigorous explanation by the augmentation of the capillary action of the water on the mercury; but having also observed that a drop of mercury electrified under water exhibits motions precisely similar, though less marked, he hence concludes, that attraction at sensible distances has a share in these phenomena.

Whoever repeats the experiment described in my paper, where a drop of mercury is placed under sulphuric acid between the two poles, even many inches asunder, and has witnessed the extraordinary activity with which it darts to the negative pole, like a ball of iron to a powerful magnet, will undoubtedly believe, as I myself did when I first observed an effect so surprising, that a more evident case of attraction and repulsion at a distance was never exhibited, and that a new species of magnetism was here produced. Yet the analysis given of this phenomenon in my paper is sufficient, I presume, to convince any one of the absence of all traces of such attractions and repulsions, and to demonstrate the justice of the explanation there given of it, viz. the reaction of the fluid and the bottom of the vessel on the mercurial currents, which radiate in all directions from the point in the globule opposite to the negative pole, along its surface, and return along its axis, keeping up a constant circulation; and that an increased capillary attraction has absolutely nothing to do with it.

The most interesting part of Professor Erman's paper is his account of the circulation which takes place in mercury when electrified in contact with conducting fluids. He has seen and described the circulation of mercury under sulphuric acid, and carbonate of potash; and has thus undoubtedly anticipated much that I believed new in my investigations.

His account of these phenomena (which he calls galvanic figures) he concludes with this remark, that "These phenomena incontestably originate in an increase of cohesive attraction of the two fluids." An increased cohesive attraction between two fluids will make them adhere more firmly to each other; it will alter, while it lasts, the figure of equilibrium of their common surface; but it is contrary to every principle of mechanics to attribute to it regular, continued, violent, and extensive internal motions, and a subversion of all equilibrium.

So far Professor Erman. It will readily be seen by the foregoing sketch, how far his researches extend. Whatever we may think of his theory, two LEADING FACTS, that regular and constant motions arise in fluids under the influence of the Voltaic current passing over mercury, and that these motions vary with the nature of the fluids, are certainly his discovery, and I most gladly yield him the priority. Every thing beyond this in my Bakerian Lecture,—the minute analysis of the phenomenon, the influence of variations in the electro-chemical nature of the fluid,—the intense effect of alloys of almost infinitesimal portions of the electro-positive metals present in the mercury, and the comparative inertness of the electro-negative ones,—the explanation of the complicated anomalies presented in these delicate experiments,—and the reference to one general fact, of the innumerable minute and enigmatical phenomena observed both by myself, and by M. Serrulas in his very curious papers in the Journal de Physique, on the rotatory motions assumed by the alloys of potassium when floated on mercury under water,—I think I may fairly claim. The subject is certainly of the highest interest, and merits every attention from the electro-chemical philosopher; and indeed, from the physiologist, when we consider the bearing which the discovery of mechanical powers, exerted by electricity, may, one day, have on that most mysterious of physiological problems, the origin of muscular motion.

Although no visible effect in producing, suspending, or altering the radiating currents appeared in my experiments to arise from the presence of powerful magnets, yet, as it seemed not impossible, that the mutual action of the elementary electric currents traversing the mercury and the supernatant liquid, (probably with very different velocities,) might determine motions in the media transmitting them, and thus be at the bottom of the whole, I resolved to put this to the test of experiment, as follows: I divided a saucer into two equal cells, by the thinnest film of mica I could detach, and secured the insulation of the cells from each other by sealing-wax. I then filled them to the same height with perfectly clean dry mercury, and having prepared two piles of 10 pairs each, in full action, I completed the circuit of the one in the one cell, and of the other in the other. But whether the currents passed in the same or in opposite directions,—whether the contacts were made close to the mica or at a distance from it,—whether both piles were in action, or one only,—whether their actions were equal, or one was purposely rendered feebler than the other, or totally abstracted, or united to the other, not the slightest motion was produced in either cell. When the two currents were transmitted at once through sulphuric acid over mercury, their effects seemed to be merely superposed, no appearance of interference arising; but each molecule of the mercury obeying their joint impulse, apparently according to the usual mechanical laws of the composition and resolution of motions. It is not, therefore, in the magnetic vortices that we are to look for the cause of these motions, but in some new and singular action of electricity, to develope which more fully will require numerous and delicate experiments.

I have the honour to remain,

Dear Sir, very truly yours,

J. F. W. Herschel.

London, Jan. 21, 1825.

Art. II.—*Analysis of a Peach-Blossom Coloured Mica, from Chursdorf, near Penig, in Saxony.* By C. G. Gmelin, Professor of Chemistry in the University of Tübingen. Communicated by the Author.

The researches of M. L. Cordier [*] had made it extremely probable that Mica and Lepidolite are one and the same mineralogical species. By the discovery of lithion in Lepidolite, there was established a difference between these two minerals, which, though it might not prove a specific diversity, according to the views of mineralogists, was still interesting to the chemist, and explained the great difference in the degree of fusibility of both minerals. But though Lepidolite and Mica very nearly agree with each other, as well in their physical relations as, on the whole, in their chemical composition, yet the argument for such an identity is strengthened by the discovery of a real Mica with large laminæ, fully agreeing in chemical composition with Lepidolite.

Considering that Amblygonite, a mineral which, among those hitherto known, contains the largest quantity of lithion, occurs in a newer granite, together with a great many other minerals, as Tourmaline, Mica, Topaz, Albite, Apatite, &c. I supposed that this alkali might not be found exclusively in amblygonite, but might also occur in other fossils accompanying it, as it forms an ingredient of spodumene, lepidolite, tourmaline, minerals that occur in the Island of Uton. I requested, therefore, my friend, Mr Breithaupt, to provide me with specimens of fossils found in the neighbourhood of amblygonite. Amongst these the peach-blossom coloured Mica first attracted my attention, and reminded me of Lepidolite by its exceedingly great fusibility. By the purple colour, which I afterwards perceived in the flame of the blow-pipe in which this Mica was melted, I became fully convinced of the presence of lithion in this Mica, and of its identity with Lepidolite.

A. *Specific Gravity of this Mica.*—Three very pure bits weighed in the air 5.08 grammes. Having been previously freed from adhering atmospheric air by means of a moistened pencil, they weighed in water of + 9⅓° Reamur, 3.293 gr.

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[*] Gilbert's *Annalen*, vol. xi. p. 250.

The specific gravity of this Mica would accordingly be $= 2.8427$, at $+ 9\frac{1}{3}°$ R. Eight hours after, during which time the bits were lying in water, the specific gravity was found $= 2.8603$, the temperature of the water being $+ 9\frac{1}{2}°$ R. After three days, when they had always been lying in water, the specific gravity was $= 2.8929$, at $+ 10\frac{1}{2}°$ R. Their weight in water no longer changed in a sensible manner. These variations in the specific gravity evidently depend on air interposed between the laminæ of this Mica, which is by degrees displaced by the water when it is lying in this fluid, whereby the specific gravity is increased.

B. *Relations before the Blow-Pipe.*—This Mica fuses so readily, that very thin laminæ, when held in the flame, without blowing upon it, melt to a globule. In the flame which is as usual blown at, even thick laminæ quickly melt (swelling up, and imparting to the flame a beautiful purple colour) to a white glass, full of blisters, which, at the moment when it is removed from the flame, is transparent, but soon becomes opalescent. In the matrass, it gives off water which tinges Brazil wood paper yellow, and contains, of course, fluoric acid; the glass is somewhat corroded. Borax dissolves it in large quantity to a clear glass, which has an amethyst colour in the oxydating flame, but is discoloured by the interior flame. Salt of phosphorus dissolves it, leaving a skeleton of silica; the glass opalesces a little after full cooling, and then also the manganese reaction is perceived, which becomes much more distinct by means of nitre. Soda dissolves it with effervescence to a clear glass, having an amethyst colour from manganese. Upon a platinum lamina, the green reaction of manganese is very marked. Moistened by nitrate of cobalt, it becomes blue, when melted.

C. ANALYSIS.—1. *Determination of the Bases.*—1.402 grammes were cleft thinly by a knife, then cut into small quadrangular pieces by scissars, mixed with six times their weight of carbonate of barytes, and ignited in a platinum crucible. During one hour, the crucible had been kept moderately red-hot, when, during half an hour, the fire was increased to whiteness. The ignited mass appeared half melted, and of a green colour; the form of the micaceous laminæ, which now showed a deep green colour, was still discernible in it.

a. The mass was soaked in the crucible with water as much as possible, and put into a glass; the rest, firmly adhering to the crucible, was dissolved by muriatic acid, which was quickly heated and poured off again, that it might not act too much upon platina by its evolving chlorine. The whole mass was now dissolved in muriatic acid. The red solution formed was evaporated to full dryness in a porcelain dish. The dry mass being soaked in water, some muriate of platina and potash, together with silica, was left undissolved. The silica was put upon a filter, and washed. It weighed, after ignition, 0.7526 gr. = 52.259 per cent.

b. The liquid was then precipitated by sulphuric acid, the sulphate of barytes put upon a filter, and washed out. It was now again precipitated by caustic ammonia, the precipitate dissolved in muriatic acid, and the muriatic solution boiled with an excess of pure potash. From the alkaline solution alumine was thrown down in the usual manner. It weighed, after ignition, 0.3974 gr. = 28.345 p. c. When dissolved in sulphuric acid, and mixed with sulphate of potash, it crystallized entirely into alum.

c. The residue left undissolved by potash was reckoned to be pure oxide of manganese, without sensible traces of iron; it weighed, after ignition, 0.057 gr. = 4.065 p. c. of oxide of manganese = 3.663 p. c. of protoxide of manganese.

d. The liquor (in *b*) from which barytes by means of sulphuric acid, and then alumine and oxide of manganese, by means of ammonia, had been thrown down, was evaporated, and the residue ignited. The fused mass being dissolved in water by the assistance of a few drops of muriatic acid, was mixed with hydrosulphuret of ammonia. The sulphuret of manganese precipitated was decomposed by muriatic acid, the acid solution precipitated by carbonate of potash, and the oxide of manganese obtained, already accounted for in No. *c.* The liquor separated by the filter from the sulphuret of manganese was evaporated, and the residue melted; there remained 0.394 gr. of a salt, which was dissolved in a little water By adding muriate of platina to this solution, a considerable precipitate was formed, composed of muriatic acid, oxide of platina, and potash. The solution, freed from potash, was now evaporated, and strongly ignited. The fused salt was dissolved in water, in order to separate metallic platina, which had been formed, evaporated, and melted. There were obtained in this way, 0.215 gr. of sulphate of lithion = 0.067187 gr. of lithion = 4.792 p. c. These 0.215 gr. sulphate of lithion being deducted from the whole quantity of the sulphate, (= 0.394 gr.) there remain 0.179 gr. sulphate of potash = 0.096785 gr. of potash = 6.903 p. c.

It need scarcely be observed, that it was proved, by the appropriate tests, that the salt considered as sulphate of lithion was really nothing else; and that it was converted into a carbonate, in which form lithion is characterized by its slight solubility, as well as by its action upon metallic platina, &c.

This Mica is accordingly composed of—

Silica, - -	52.259 (*a*)
Alumine, - -	28.345 (*b*)
Protoxide of manganese, -	3.663 (*c*)
Potash, - -	6.903 (*d*)
Lithion, - -	4.792 (*d*)
	95.957

2. *Determination of the Quantity of Fluoric Acid.*—In order to determine the quantity of fluoric acid, the method used by Professor Berzelius in his analysis of topaz was followed. 2.627 gr. of mica, finely cut, were ignited with three times their weight of subcarbonate of soda. There were obtained 0.478 gr. of strongly dried fluate of lime = 5.069 p. c. of fluoric acid. This fluate of lime was decomposed by sulphuric acid, the excess of acid, for the greatest part, driven off by heat; and the mass then digested with alcohol, filtered, evaporated, and ignited. But there remained no trace of phosphoric acid.

This peach-blossom coloured Mica is therefore composed of—

Silica, - - -	52.254
Alumine, - - -	28.345
Protoxide of manganese, -	3.663
Potash, - - -	6.903
Lithion, - -	4.792
Fluoric acid, - -	5.069
Traces of water, - -	
	101.026

3. *Search after Oxide of Titanium.*—Mr Peschier of Geneva thought that he had discovered oxide of titanium in se-

veral species of mica; but it appears clearly, from the experiments of MM. H. Rose and Vauquelin, that, in so far as respects the quantity of the oxide of titanium, this chemist is quite in the wrong. As Mr Vauquelin, however, has himself discovered in several specimens of mica, which he recently subjected to analysis, traces of titanium, I did not omit to examine whether or not this Mica also contains titanium. I followed exactly the method proposed by Mr Vauquelin, * which is certainly well fitted to discover the smallest traces of this metal in a mineral, but I was not able to detect unequivocal traces of it. Muriatic acid, which was boiled with the silica, separated by evaporation in a water bath, had taken up nothing but a little chloride of silver, (derived from the crucible in which the mineral had been ignited with potash,) which was thrown down by water; and by adding afterwards an infusion of galls, no fusible precipitate fell down. The chloride of silver, somewhat coloured, was, however, collected and examined before the blow-pipe with salt of phosphorus. There was obtained metallic silver; but the glass assumed, even after the addition of tin, such an undecided reddish hue, that the reaction could not be considered as a decided one. The other ingredients of this Mica contained no trace of titanium.

With respect to the lithion, which Mr Peschier conceives he has discovered in a species of mica, it appears not improbable that this chemist has likewise been deceived, and that he has considered to be lithion what is really magnesia. His experiments, at least, by no means prove the presence of lithion, but rather of magnesia. I tried several pieces of mica before the blow-pipe, but could not discover this alkali, not even in a rose-red mica from North America, for which I am indebted to my friend, Mr Brooke.

It is evident, that the Mica from Chursdorf is nothing else but a largely lamellated Lepidolite; and it might, therefore, be more adequate to distinguish the micas that contain lithion together with potash, from those which contain no lithion, by the name of lithion-mica. It appears, besides, that potash is as essential an ingredient of Lepidolite as lithion, and that Le-

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* *Annales de Chimie et de Physique,* par MM. Gay-Lussac et Arago, t. xxvii. p. 67.

pidolite, therefore, cannot be considered as a mixture of common (potash) mica with lithion-mica. Amongst the different species of mica which occur in the same tract, I have discovered some which bear a great resemblance to Lepidolite commonly so called, being composed of small lamellæ agglutinated to larger masses ; others, on the contrary, possessed of similar external characters, contained no lithion. The easily fusible micas in the Dolomites of St Gotthard, mentioned by M. Cordier in his *Treatise on Lepidolite*, are most likely lithion-micas, but I have had no opportunity of examining them.

It may be observed, that the presence of lithion in a mineral seems to exclude a larger quantity of iron ; I made this observation, when I examined several species of tourmaline, of which those that contained much iron never contained lithion ; and even the black tourmaline, which occurs along with lithion-mica near Chursdorf, can at least contain no large quantity of lithion, as it does not tinge red the flame of an oil lamp. On the other hand, lithion seems to associate more readily with manganese, as may be seen in the tourmalines and micas that contain lithion. The lithion-micas contain likewise a larger quantity of fluoric acid than common micas.

In the formations of the neighbourhood of Penig, lithion seems to be considerably diffused. Near Hartmansdorf, between Chemnitz and Penig, a peculiarly formed quartz is found in serpentine, composed of agglutinated round concretions, whose fracture exhibits fibres diverging from a common centre. Splinters of this quartz tinge the flame somewhat red, which does not happen with a splinter of rock-crystal when treated in the same manner. I could not, however, decidedly prove by analysis the presence of lithion in this quartz. I obtained 99.57 p. c. of silica, with traces of iron and alumine, and equivocal traces of lithion. In a manner a little more decided, this alkali is manifested by the blow-pipe in the Andalusite, which formerly was found in a mass of granite imbedded in Weiss Stein, in a valley between Penig and Rochsburg. But in a most unquestionable manner lithion is discovered in this way in a substance which is found adhering to the quartz already mentioned in small particles. This substance has a wax-yellow colour, is unctuous to the touch, very soft, a little transparent, and may be spread with a knife upon paper. It seems to be the *Kerolite* of Mr Breithaupt,* and it occurs under the same geognostic relations. It does not melt before the blow-pipe, becomes white, and imparts to the flame a beautiful purple colour. I shall communicate the analysis of these minerals in another paper.

ART. III.—*Observations on the Optical Structure of Lithion-Mica, analysed by Professor Gmelin.* By DAVID BREWSTER, LL. D. F. R. S. Lond., and Sec. R. S. Edin.

As Professor Gmelin had the goodness to transmit to me, along with the MSS. of the preceding paper, some specimens of the Lithion-Mica, with a request that I would examine its optical structure, I lost no time in complying with his wishes.

In the year 1816, while examining the various Micas, I found that the inclination of the resultant axes of Mica and Lepidolite was 45°; and that other Micas had their axes inclined only about 14°, while in talc they formed so small an angle as 7° 24′. I afterwards found two Micas from Greenland, in large masses, which had only one *negative* axis of double refraction. M. Biot, who also performed many accurate experiments on Mica, found specimens in which the inclination of the axes was 30°, 31°, 32°, 34°, and 37°, and some in which it was under 25°. He discovered also some Micas which had a single *positive* axis, and when these specimens were analysed by M. Vauquelin, the *uniaxal* crystals were found to contain magnesia, while in the *biaxal* ones there was not even a trace of that earth; and the inclination of the axes seemed to diminish as the oxide of iron increased.

Under these circumstances, the examination of the Lithion-Mica became more than usually interesting. Upon exposing the plates sent me by Professor Gmelin to polarised light, I was very much struck with their compound appearance. In place of being individual crystals, like almost all the specimens of Mica that I had examined, they were obviously composed of several individual crystals, having their axes lying in various directions, and producing most irregular polarised tints. A more particular examination, however, led me to observe the remarkable fact, *that these plates of Lithion-Mica were composed of crystals with one axis, united to crystals with two axes,* and without the appearance of any joint or face of composition. By insulating the uniaxal portions, which occupied much less space than the biaxal ones, I found that the character of their axis was *negative;* and by insulating the biaxal portions, I found that the inclination of the resultant axes, after refraction, was almost exactly 45°, the principal axis being also negative. The inclination of the axes before refraction was 70°. In some other parts of the plate, which where irregularly crystallised, I found the angle so high as 74° and 75°.

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* *Charakteristik des Mineral Systems*, 2 te Aufl. p. 145.

Now, as all the uniaxal crystals of Mica that have yet been analysed, differ from the biaxal ones in chemical composition, we would recommend it to Professor Gmelin to detach, if possible, all the uniaxal parts from the biaxal parts, and to make a separate analysis of both. If he shall find, what analogy authorizes us to expect, that these two portions are chemically different, the result will be a most important one, both for mineralogy and for analytical chemistry. It will set aside all analyses of minerals, where it is likely that the body analysed has not been an *individual* crystal, and it may thus establish, upon a firmer basis, the law of definite proportions.

In examining the Lithion-Mica with a microscope, I noticed, in various places, considerable portions of a substance lying between the laminæ, which was of a bright scarlet colour, whether seen by reflected or transmitted light. It is now indurated, but seems, from its outline, to have been once fluid. The origin and nature of this substance deserve to be investigated.

ART. IV.—*Description of a Boat with a Revolving Paddle Scull,* Invented by ANDREW WADDELL, Esq. F. R. S. E. Communicated by the Author.

THE following is a sketch of a Boat with a revolving Paddle Scull, of which an experiment was made in May 1824, on the Inner Basin of the Wet Docks of Leith, by Mr Waddell of Hermitage Hill.

The boat was twenty-six feet long, and six feet broad, and was propelled by means of the revolving scull projecting from the stern, and wrought by two men with a crank, or winch handle, attached to the inner end of its spindle or axis.

The propelling part of the scull was formed of two thin iron plates, each eleven by ten inches in size, producing a surface of 220 inches in whole, which gave a velocity to the boat of four and three-fourth miles per hour. But as the after part of the boat was confined, and the labour in working the scull very great, the men were soon fatigued, and enabled to continue their operations only for a short period.

This invention of Mr Waddell's promises to be of considerable utility, and, when operated on by a constant power, to produce great velocity. But to attain the best effect, the scull must revolve from eighty to ninety times in one minute. It may be applied to any vessel, and so placed as to be raised out of the water at a moment's notice, without interfering with the movement of the vessel when under sail.

In the various experiments Mr Waddell has made on small models of vessels, during the last five or six years, with propelling machines of different descriptions, he has found the revolving scull to produce the greatest velocity with the least power. In smooth water and light winds, it exceeds the paddle-wheels in general use by one-fifth or more; but in strong head winds, with heavy sea, Mr Waddell is of opinion, that the paddle-wheels would have the advantage.

This scull might be of great utility in ships of war, when in action, during calms and light winds, by presenting with facility the broadside of the ship towards the enemy; and for that purpose, might be wrought from a bow or after porthole on the lower gun-deck, with less than half the number of revolutions stated.

The boat, with the propelling apparatus, &c., is represented in Plate IV. Fig. 1.

AA, the boat, which draws about eighteen inches of water.

BB, the scull in its proper place when propelling the boat, the spindle or axis of which being an iron rod of about one inch diameter passing through an aperture in the stern-post, and having its inner end fixed to an universal joint connected with rack and pinion work, which operates within board.

CC, the scull, when not in use, is drawn up through the above mentioned aperture, which is elongated for that purpose, and fixed by a rope and small block attached to it at the upper part of the stern of the boat at D.

E, the rack and pinion work, secured by strong iron plates to a thwart near the stern of the boat, consists of two pinion wheels, the axes of which are horizontal, and in the line of the keel of the boat; and the lower pinion wheel is one-half the diameter of the upper one, and has the universal joint at F fixed to the after-end of its axis, which being united to the scull in its diagonal position, and wrought by means of the crank GG, fixed to the fore-end of the axis of the upper pinion wheel by the two men at H, produces an increased velocity, and accelerates the motion of the vessel.

The paddle plates at the extremity of the axis of the scull are placed at right angles to each other; and at an angle of 45 degrees with the said axis or spindle, and are secured to each other in that position by a strong iron strap, in the centre of which there is a square aperture to receive the outer end of the axis of the scull, to which it is fixed by a screw nut.

HERMITAGE HILL, *February* 5, 1825.

ART. V.—*On the Dispersion of Stony Fragments remote from their Native Beds, as Displayed in a Stratum of Loam near Manchester.*[*] By SAMUEL HIBBERT, M. D. F. R. S. E. and Secretary to the Society of Scottish Antiquaries. Communicated by the Author.

THE important researches of Professor Buckland, on the supposed evidence of diluvial action afforded by deposits of loam and gravel, are now beginning to excite the attention which they so well deserve. This geologist has proposed to separate two classes of phenomena, which were previously referred to one common cause. Of these, the *first* is the general dispersion of gravel and loam over hills and elevated plains as well as vallies, which he conceives to be the effect of an universal and transient deluge. To the gravel and loam thus said to be dispersed, the name of *Diluvium,* in reference to their alleged cause, has been given. The *second* class of phenomena includes the partial collection of gravel at the foot of torrents, and of mud at the mouths, and along the course of rivers; this partial collection of gravel, mud, or sand, being distinguished by Professor Buckland, from the first class, by the name of *Alluvium*. Thus, we are said to have deposits either of *Diluvium* or of *Alluvium*,—the first of these being referable to the action of an universal deluge, the latter (or the alluvium) to that of existing causes. Into the reasonableness of this view, it is not my proper business at present to inquire; nor is the individual who may be inclined to follow up the researches of Mr Buckland, obliged to admit that the evidence which has been adduced is perfectly conclusive. The validity of the theory must rest upon a much greater number of observations than we at present possess; and, in the meantime, it is less the duty of the geologist to contend for the speculative distinctions, which a far too limited sphere of research has prematurely suggested, than simply to commit to record all appearances of transported materials which occur either in the form of gravel, or which are imbedded in loam. Under this impression, therefore, the following notice on the subject is now submitted to the Society.

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[*] Read before the Royal Society of Edinburgh, January 3, 1825.

Professor Buckland has prominently adverted to the very remarkable deposit, considered by him as *diluvial*, which is to be found on the east coast of England; this consists, in general, of a tenacious blue clay. I have examined that of Yorkshire with some degree of attention. Innumerable fragments of primitive rocks are imbedded in it, which, it is supposed, cannot be identified with any that exist in Great Britain, but are referable to those of Norway. This assertion, however, is unsatisfactory, unless it can be shown that the fragments thus dispersed have (like those of the vicinity of Edinburgh, which were the subject of Sir James Hall's truly philosophical paper) been, *bona fide*, made the subject of comparison. Whether this has been actually done or not, we are by no means informed. In order, then, that a comparison of this kind may be carefully instituted, I shall now notice a deposit of loam, (to which Professor Buckland would not have the least hesitation in assigning the name of *diluvial*,) the imbedded stony fragments of which appear derivable, not from the Continent, but from the rocks of our own island. This deposit, which consists of a thick continuous bed of clay, very tough, and of a reddish or yellowish brown colour, is to be seen on the north of the town of Manchester, near Strangeways Hall, an ancient family seat of Lord Ducie. It stretches in a direction from north to south, being interrupted by the cliffs of the newer red sandstone formation which are exposed at the confluence of the rivers Irk and Irwell. How far from this point the bed extends, I am unable to state, but am inclined to think it must be considerable, since I have observed the same kind of stony fragments, which are to be found in the loam of Strangeways, employed for several miles north in repairing the highways. I am equally unable to assign any limits to the breadth and thickness of this deposit, which are various. As the clay near Strangeways is now in the progress of being cut away for the purpose of brick-making, as well as of widening a road, sections are observable in it to the height perhaps of thirty feet, or more. But this is very far short of its real thickness. The principal circumstance relative to it deserving attention is, that innumerable fragments of rocks, some of which seem of several tons weight, are constantly detached from it by the labourers; and that, while the rocks of this part of Lancashire consist of the newer red sandstone, or of the red marl of geologists, many of the fragments included in the loam are of a much older date, since they belong to the primitive or transition class of formations, and have been evidently transported from a considerable distance. Granite, a stranger to the rocks of this district, is abundantly interspersed through the loam, most of the specimens of it containing hornblende in greater or less quantity. Several varieties of trap-rock, particularly of greenstone, equally unknown *in situ*, are no less common. Other loosened relics of the hills, of far remoter districts, possess a stratified structure, and consist chiefly of the rock named by most geologists grauwacke-slate, but by Dr Macculloch, with far greater propriety, argillaceous schist. It has a basis of clay-slate, with much quartz, disseminated through it in the form of granular particles. Some fragments of this rock have a decidedly conglomerate structure, containing numerous attrited nodules of granite. Another variety of stony materials found in the loam may be described as a bluish quartz, which, when it existed *in situ*, was probably interstratified, or otherwise associated with the argillaceous schist already described. The quartz-rock is far more abundantly found than the grauwacke, owing, probably, to its having been better enabled, from its peculiar chemical nature, and from its superior hardness, to resist the processes of disintegration.

Such, then, is the character of some of the imbedded masses which occur in the loam of the south-east of Lancashire, and, from the recollection which I have of the rocks of Westmoreland, little doubt remains in my mind, but that these dispersed fragments will be found to correspond with them, and that the particular site of the grauwacke district, to which they are referable, may, with the greatest precision, be identified. This has been, in fact, the impression of some other geologists, when they have adverted in a very general manner to the boulders strewed over the plains of Lancashire and Cheshire; but a mistake has been assuredly made, in supposing that they might be identified with the rocks in the vicinity of Shap Fells, in Westmoreland. Now, I have never found the very peculiar porphyritic granite, that characterises this district in the loam which I am now describing. I am inclined, therefore, to consider the fragments as transported from a different place, perhaps from the vicinity of Dufton, near Appleby. But the exact determination of this point will be my object on some future occasion. I shall merely remark for the present, that as no rocks *in situ*, similar in their nature to the fragments which are found imbedded in the loam of Manchester, can be anywhere found nearer than 80 miles from this town, no small degree of support is given to the conclusion, that an overwhelming force, most probably from the North, far greater than any which can be attributed to existing causes, has transported these boulders to a situation so very remote from the place whence they were originally detached.

But, besides the granite, greenstone, quartz, and argillaceous schist, which occur in the loamy deposit of Lancashire, I have also noticed fragments of newer rocks. These consist first of a very dark-coloured limestone, (the carboniferous or mountain limestone of English geologists,) which, from being unlike any specimens of the kind that I have seen in the adjoining south-easterly county of Derby, may have been detached from some limestone hills in a more northerly direction. Other numerous fragments which the loam contains are of sandstone, *shale*, and coal, these having been most probably removed from the extensive coal district of Lancashire, which is intermediate to the red marl formation of Manchester, and to the Westmoreland hills of grauwacke and granite.

Thus, then, it appears, that a considerable bed of loam, to be found in the south-east of Lancashire, contains imbedded fragments of rocks, which have been dispersed from a far distant northerly district of Westmoreland, where the rocks consist of granite, trap, grauwacke, and quartz; that the same clay contains specimens which have been removed from a remote district of mountain limestone, and that it likewise furnishes evidence of a similar transportation having been effected of the stony materials which compose an intervening district of the coal formation; each of the districts, from whence the materials have been removed, lying to the north of the loam in which they are found to be deposited.

I shall, lastly, observe, that most of the transported fragments of rocks, which have come under my observations, appear to be water-worn. I noticed, however, some fragments which showed few or no marks of attrition.

These are the few remarks which I shall at present offer on the transported materials of rocks that occur in the south of Lancashire. They have been suggested by a consideration of the interesting researches which Professor Buckland has of late been so actively pursuing. Whatever may be the true theory which the labours of this indefatigable geologist are calculated to support, our obligations to him must remain unaffected. Yet, it must be confessed, that we have at present too few observations from which the important question can be solved, whether the transportation of stony fragments, so far from their native beds, be referable to an event of such an universal nature as the Mosaic deluge, or to far more partial causes. But granting even the latter supposition, namely, that a partial cause may have contributed to produce an effect of this kind, still we must admit, that it far exceeds any ordinary operation of nature with which we are conversant at the present day.

ART. VI.—*Table of Tides kept at the Mouth of Macquarrie Harbour, in Van Diemen's Land, between July 21st, and September 27th,* 1822. Communicated by his Excellency Sir THOMAS BRISBANE, K. C. B. F. R. S. L. & E. &c.

DATE.	HIGH WATER.	LOW WATER.	TIME OF FLOWING.	TIME OF EBBING.
1822.	*H. M. Past.*	*H. M. Past.*		
July 22	5 10 P. M.	8 0 A. M.	. . . .	14 hours 50 min.
23	4 30	8 30	8½ hours.	16 hours.
24	4 0	9 0	7½ do.	17 do.
25	5 30	8 30	8½ do.	15 do.
26	6 0	10 0	9½ do.	16 do.
27 28 29	. . . .	. . . .	3 days.	. . . .
30 31	. . . .	. . . .	. . . .	2 days.
Aug. 1	4 30 P. M.	6 0 A. M.	. . . .	13½ hours.
2	5 0	6 0	11 hours.	13 do.
3	5 10	7 0	10 do. 40 min.	13 do. 50 min.
4	5 30	7 10	10½ do.	13 do. 40 min.
5	4 0	7 30	8 do. 50 min.	15½ do.
6	4 30	8 0	9 do.	15½ do.
7	5 0	8 30	9 do.	15½ do.
8	8 30	6 0	12 do.	9½ do.
9	9 0	10 0	15 do.	13 do.
10	9 30	10 30	11½ do.	13 do.
11 12 13	. . . .	. . . .	3 days.	. . . .
14	. . . .	. . . .	. . . .	24 hours.
15	6 0 P. M.	10 0 A. M.	. . . .	16 do.
16	3 0	6 30	5 hours.	15½ do.
17	3 30	6 0	9 do.	14½ do.
18	4 0	5 0	10 do.	13 do.
Sept. 8	5 30 A. M.	4 30 P. M.	. . . .	11 do.
9	4 0	5 0	11½ do.	13 do.
10	4 0 P. M.	6 0 A. M.	11 do.	14 do.
11	4 30	6 30	10½ do.	14 do.
12	5 0	7 0	10½ do.	14 do.
13	5 30	7 30	10½ do.	14 do.
14	6 0	8 0	10½ do.	14 do.
15	6 30	8 30	10½ do.	14 do.
16	7 0	9 0	10½ do.	14 do.
17	7 30	9 30	10½ do.	14 do.
18	8 0	10 0	10½ do.	14 do.
19	8 30	10 0	10½ do.	14 do.
20	9 0	11 0	10½ do.	14 do.
21	9 30	11 30	10½ do.	14 do.
22	10 0	12 0	10½ do.	14 do.
23	10 30	12 30 P. M.	10½ do.	14 do.
24	11 0	1 0	10½ do.	14 do.
25	11 30	1 30	10½ do.	14 do.
26	12 0	2 0	10½ do.	14 do.

ART. VII.—*Researches on Hydrocyanic Acid and Opium, in reference to their Counter-Poisons.* By JOHN MURRAY, F. L. S. M. W. S., &c. Communicated by the Author.

IN June 1815, a paper of mine was read to the Linnæan Society, developing a simple and apparently decisive method of ascertaining the sedative virtues of vegetable juices and their counter-agents.

The sciatic nerves of the prepared frog were taken up by a silver probe, and moistened with the tincture, and the result indicated the sedative power or its obverse; the degree was determined by the specific gravity of the solution employed, and the power measured by the duration of the period required to produce its maximum effect.

It would be superfluous now to describe what has already been amply detailed. It was clearly proved from the result, that a suspension of the voltaic excitement, more or less decided, was the consequence of certain vegetable juices, and that in such as were operative in this manner, acetic acid was found to be a counter-agent.

It may be worthy of remark, in this place, that discoveries have since manifested new alkaline bases, characterized by specific characters, in such as having produced a sedative effect, were neutralized by acetic acid, as *morphia*, *atropia*, &c.

The following paper is intended simply to detail the results of some experiments instituted with reference to the discovery of counter-poisons to their agency on the system. Facts are soon stated, and it is not necessary that they be amplified or extended by unnecessary details. The truths gleaned from actual experiment are immutable, while the consequences which may be deduced in support of a theory may soon be overlooked in the progress of intelligence.

I had always found, that the violent headache which sometimes occurred in preparing hydrocyanic or prussic acid, was relieved and removed by *ammonia*, which induced me to think, that the antidote to that acid and virulent and formidable poison might be found in ammonia.

A small portion of hydrocyanic acid was given to a healthy young rabbit, which proved fatal in ten minutes. Soon after its administration, the head declined on one side. Violent spasms supervened, while the eye lost its lustre, and the animal died in dreadful convulsions.

On dissection after death, the lobes of the lungs appeared paler than usual. Coagulable lymph was found lining the trachea as in cynanche tr., and the stomach was found inflamed near the pylorus. The brain was not examined.

The muscular fibre was still excitable by voltaic agency, but the excitability soon declined.

A drop or two of hydrocyanic acid on the head of a frog soon proved fatal. The colour promptly changed to an unwonted paleness.

The sciatic nerves of the prepared limbs were moistened with hydrocyanic acid, but no suspension of the voltaic excitement supervened. It was accompanied by a tremulous movement of the muscular fibre connected with the lines of the nerves, and this spontaneous irritability seemed increased by the application of an alcoholic solution of iodine.

It is a singular fact, that not unfrequently the alcoholic solution of iodine dropped on the muscular fibre of a frog excited phenomena similar to the action of the voltaic apparatus. It seemed also to renew excitability when the susceptibility had declined, or was lost.

When the symptoms were verging to a fatal issue, (in a frog,) a drop or two of ammonia on the head effectually restored the animal.

A greater quantity of hydrocyanic acid was given to a young rabbit than proved fatal in the case detailed. Ammonia was occasionally applied to the mouth on a sponge. The animal exhibited no unhealthy symptoms whatever.

A considerable quantity of hydrocyanate of ammonia, with excess of base, was administered to another rabbit, but without any deleterious effect.

Half a drachm of hydrocyanic acid was given to a healthy young rabbit. The effects were prompt. Respiration became laborious and difficult, with a grating in the throat; the eye lost its brilliancy; the head dropt. It raised a sharp cry, and was convulsed. Strong ammonia was dropt into the animal's mouth, and it was repeatedly wetted with a sponge dipt in ammonia. It almost instantly revived, and even *licked repeatedly the finger* which sometimes applied the ammonia, apparently quite sensible of the instant and continued relief it afforded. The animal effectually recovered. Its lips were excoriated by the ammonia.

Conscious of the complete antidote to this formidable poison found in ammonia, I took a quantity of hydrocyanic acid, sufficient to produce violent head-stupefaction, &c. but diluted ammonia afforded me instant relief. I occasionally applied it to the olfactory organs, and bathed the forehead.

Since hydrocyanic acid has been introduced into our Pharmacopœia, and employed in *phthisis pulmonalis*, and accidental poisoning may be anticipated, it is of much moment to know an effectual barrier to its virulence; and such is my complete conviction of the antidote, that I would feel no hesitation whatever in taking a quantity sufficient to *prove fatal*, provided there stood by a skilful hand to administer the remedy.

It is admitted, that *morphia* is the active principle in opium. Morphia dissolved in alcohol, in which, however, it is sparingly soluble, produced on the sciatic nerves of a prepared frog effects analogous to those of the tincture of opium. Acetic acid restored the voltaic excitability.

The sciatic nerves were moistened with superacetate of morphia, but the excitement was the same as if none had been applied.

A frog's head and abdominal viscera were steeped in superacetate of morphia, but the voltaic action remained unhinged.

Half a drachm of superacetate of morphia was given to a young rabbit, but no apparent derangement of its healthy functions took place. It rather seemed to act as a stimulus to appetite.

These experiments pointed out *acetic acid* as the counter-poison to opium; and, from its volatile properties, and other characters in which it differs almost essentially from acetic acid, having no affinity with it, except in an acid character, and having much of the features of an ether, I am of opinion that acetic acid may prove serviceable, where acetous acid would not prove effectual.

Two and a half drachms of tincture of opium were given to a rabbit. In a short time the eye became more opake. The pupil dwindled to a mathematical point, and was insensible to the stimulus of light. The head fell to the floor—the breathing was laborious and difficult, and loud—and there supervened a total prostration of strength. *Acetic acid* was then administered through a quill, and applied to the mouth on a sponge repeatedly. The head was also bathed with acetic acid; and it was also applied to the extremities, and in the direction of the spine. The whole quantity of the acetic acid used was about a fluid ounce. The animal was also frequently roused, and finally kept warm. The animal effectually recovered.

These experiments were repeated with uniform success on other rabbits. Several days have elapsed, and they continue in the most healthy condition.

I much regret that these experiments have been so painful to me, as to cause for some time an interruption of my researches on *Hyoscyamus niger*, *Atropa belladonna*, *Cicuta virosa*, and other vegetable poisons; and nothing but the high importance which might attach to the discovery of an antidote to their fatality could have induced me to commence these experiments.

I have no hesitation to pronounce with most positive certainty, that in ammonia will be found a complete antidote to hydrocyanic acid, and in acetic acid an effectual counter-poison to opium.

The agency of voltaic excitement holds out a method to discover the comparative sedative or narcotic properties of vegetable juices, as well as their counter-agents. It unfolds also those that are stimulant, and those that are not, with their relative correctives. By this means, we are prepared, by well-grounded anticipation, for the successful application of an antidote.

ART. VIII.—*Description of Withamite, a new mineral species found in Glenco.* By DAVID BREWSTER, LL. D. F. R. S. Lond., and Sec. R. S. Ed.

THE mineral, of which I propose to give a short description, was found by Henry Witham, Esq. in Glenco, in Argyleshire, during a mineralogical excursion which he made to the Highlands of Scotland, in the month of August 1824.

The mineral occurred in a trap-rock of a reddish brown colour, and was disseminated in grains, or in small masses, which shot out into regular crystals in the larger cavities. These crystals are very minute, seldom exceeding the 100dth part of an inch in diameter. They occur in radiated spherical groupes, the central parts of which are of a light red colour, while, towards their circumference, they terminate in separate crystals, which, by reflected light, have a dark red colour, like that of arterial blood. Very fine groupes of transparent crystals sometimes penetrate the quartz which occasionally accompanies the mineral; and when thin chips of this quartz are immersed in Canada balsam, which has nearly the same refractive power as quartz, and submitted to a powerful microscope, the separate crystals of the mineral are displayed with peculiar advantage.

Having succeeded in detaching some minute crystals from specimens submitted to me by Mr Somerville, who accompanied Mr Witham to the Highlands, I found that they had generally the form of an irregular six-sided prism with flat summits, and that in the broken crystals there was an imperfect, though tolerably distinct, cleavage, perpendicular to the axis. In a fine specimen belonging to Mr Witham, I have since observed various faces upon the summit of particular crystals, but they are too minute to admit of measurement. The following are the angles of the prism, which I obtained by the reflecting goniometer. See Plate VIII. Fig. 1, 2.

A upon B	128° 20′	D upon E	166° 30′
B —— C	63 20	E —— F	76 0
C —— D	168 20	F —— A	118 30

Between the faces F and A, I observed other two very imperfect ones, which were inclined 156° and 147° respectively to A.

From the irregularity of this prism, of which only two of the opposite sides are parallel, Mr Haidinger, who had likewise measured the angles, was led to believe that the crystals are compound, and by computing the angles of the compound prism, on the supposition that one of the individual crystals was turned round 180°, he obtained a very satisfactory confirmation of his opinion.

The hardness of Withamite is about 6.5, scratching glass with facility. Its specific gravity, as determined by Dr Turner, is about 3.137, and the specific gravity of the rock about 2.669.

In examining the optical characters of this substance, I have experienced considerable difficulties from the minuteness of the crystals. By plunging them, however, in oil of cassia, the oil of the highest refractive power, I was enabled to ascertain that their ordinary refraction greatly exceeds that of oil of cassia,—that their double refraction, which is considerable, is *negative* in relation to the axis of the prism,—and that the two images may be easily separated by looking through any of the two acute angles of 63° or 76°.

The most interesting optical property of Withamite is its *dichroism*, or *double colour*, which it exhibits both in common and polarised light. When common light is transmitted through the two parallel faces of the prism, the tint is of a crimson or amethyst colour, with a mixture of straw yellow. Upon turning the crystal round, the yellow tint disappears, and the colour becomes a deep crimson red. On continuing to turn the prism, the colour changes to a straw yellow, and at the end of half a revolution the crystal resumes its compound tint. In the groupes of crystals which have penetrated the quartz, some of them occupy, accidentally, the position which gives the yellow colour,—others that which gives the red colour, and some that which gives the compound tint; so that, without a knowledge of their dichroitic property, the groupe might have been considered as composed of three different sets of crystals.

This mineral is not acted upon by acids either cold or hot; and it does not phosphoresce on a heated iron. The following experiments upon it with the blow-pipe were made by Mr Haidinger.

When placed alone upon charcoal it intumesces, and assumes a shape like cauliflower, but it fuses with difficulty, and has the appearance of a dark greenish grey enamel. With borax it effervesces, and forms a transparent globule, of a deep yellow colour, when hot, but becoming pale on cooling. The tint in the oxidating flame is slightly yellowish, and in the reducing flame greenish. It is dissolved with effervescence by salt of phosphorus, with the exception of a skeleton of silica. The globule is yellow while hot, but becomes white and opaque, or, at least, opaline, on cooling. With a little soda it fuses with difficulty into a deep green glass, but a larger quantity renders it infusible. With soda upon platina foil it gives a green colour, which is purer than that from the epidote of Arendal, but less inclining to blue than that from the pure oxide of manganese, or from the manganesian epidote of St Marcel. Withamite exhibits the same phenomena before the blow-pipe, as the epidote from Arendal, only it is a little more difficult of fusion. Silica, iron, and manganese, are unequivocally indicated among its constituents. Lime is probably one of its ingredients, on account of the intumescence, and the opacity of the globule when melted with salt of phosphorus.

From these experiments, and from the similarity in the crystallographic form, and composition of the two substances, Mr Haidinger, whose knowledge of minerals is unrivalled, was disposed to consider Withamite as a new and remarkable variety of epidote. I was therefore induced to re-examine a fine crystal of epidote from Chamouni, which Mr Haidinger gave me for this purpose, and to compare it, as far as I was able, with the Withamite. The result of this comparison, though favourable to the opinion, that these two minerals are closely allied in their natural history properties, was such as to convince me, that the Withamite exceeds epidote both in lustre and double refraction, and very greatly in its ordinary refractive power. This result I was enabled to confirm by another mode of observation.—Mr Somerville had put into my hands a specimen of the rock containing small masses of Withamite, which he had carefully polished. The high lustre of the Withamite was thus rendered obvious to the dullest eye; but I was surprised to observe, that the pale red mineral which almost always separates the Withamite from the trap-rock, was quite inferior in lustre to it. I therefore examined the action of these three surfaces upon light when reduced by the opposite action of oil of cassia. When the image of the sun was reflected from the surface of the rock, the light was faint, and of a pale blue colour;—when it was reflected from the surface of the Withamite, it was bright and of an orange colour; but when it was reflected from the surface of the pale red substance round the Withamite, the image was scarcely visible. Hence we conclude, that this second substance, which seems to be a new mineral, has the same refractive power as oil of cassia, and that in its action upon light it comports itself like topaz from Brazil.

Upon mentioning this experiment to Mr Haidinger, he examined the pale red substance, and considers it as having some resemblance to Saussurite.

Art. IX.—*On the Genus Hookeria of Smith, of the order Musci.* By W. J. Hooker, LL.D. F.R.S. &c. &c. Regius Professor of Botany in the University of Glasgow; and R. K. Greville, LL.D. F.R.S.E. &c. &c. Communicated by the Authors.

Hookeria.

Gen. Char.—*Seta* lateralis. *Peristomium* duplex. *ext.* e dentibus sedecim; *int.* membrana 16-laciniata, nunc ciliis alternantibus. *Calyptra* mitriformis.

The genus *Hookeria* was established by Sir J. E. Smith, in a memoir published during the year 1808, in the *Transactions of the Linnean Society*, vol. ix. and was defined there by characters, which, with very slight exceptions, we have here adopted. The well-known moss *Hypnum lucens*, is to be considered as the type of the genus; to this, Smith added *H. quadrifarium*, the *Leskea pennata* of Labillardiere, *L. filiculiformis*, Hedwig, *L. tamariscina*, *L. rotulata* of the same author, *Hookeria flabellata*, *H. Arbuscula*, *L. flexilis* of Hedwig, and

H. uncinata. Of these species, the authors of the *Muscologia Britannica*, perhaps too hastily, considered that the seven last should be rejected, as not well according with it, either in their essential character or natural habit. We have here, however, been induced to receive into the genus, *Hookeria filiculiformis*, *tamariscina* and *rotulata*,* which, however varying in habit, as they certainly do, from the type of the genus, agree with it, nevertheless, in the structure of their peristomes, and we believe, (but we cannot speak with certainty,) also in the form of the calyptra. We have indeed seen some specimens of *rotulata*, where the calyptra appeared fully formed, and was quite entire; whilst in others, even while remaining upon the capsule, we have observed it to be split on one side. Still, from the general form of this part, which may be considered as campanulate, we are inclined to think that its splitting is an accidental circumstance, similar to what we have seen, and what Schwaegrichen has figured, in *Trichostomum funale*, and which may perhaps be caused by the sudden curvature of the seta, where it is embraced by the base of the calyptra. Still we must allow that the union of these species with *Hookeria lucens*, *acutifolia*, *cristata* and *quadrifaria*, does in some measure destroy the natural habit of the genus. But this we can safely affirm, that the more we investigate the structure and character of the mosses, the more we are satisfied that the nature of the peristome will not afford characters for their natural distribution. What plants, for example, can be more similar in habit than *Cynontodium cernuum* of Hedwig, *Leptostomum inclinans* of Brown, (*Gymnostomum* of Hooker) *Ptychostomum compactum* of Hornchuch, and *Bryum turbinatum?* So much alike are they indeed, that with the eye, unassisted by the microscope, they are scarcely to be distinguished from one another; yet in their peristomes, and in them only, they are so widely different, that according to the present ideas of the arrangement of mosses, they must constitute so many distinct genera; and in the system these are placed very widely apart.

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* The Smithian *Hookeriæ*, which we think should be removed from that genus, are the species last mentioned by that learned author; viz. *Arbuscula*, *flexilis*, and *uncinata*. The two former are figured in the *Musci Exotici* as *Hypna*, and in the cylindrical stems and general habit they certainly depart from the genus *Hookeria*; at the same time we must remark, that we have not, neither has Smith, had the opportunity of seeing the calyptra. *H. uncinata* has altogether so much the habit of *Hypnum cupressiforme*, that till the discovery of its calyptra shall ascertain its true genus, we should prefer placing it among the *Hypna*.

The main characters, then, of the genus *Hookeria*, we consider to depend, first, on the lateral insertion of the fruitstalk; secondly, on the peristome being double, and like that of *Hypnum* and *Leskea*, having the inner one formed of a membrane cut into sixteen segments, with or without intermediate ciliary processes; and thirdly, upon its having a calyptra, which is mitriform.

There exists, at the same time, certain characters which are common to a considerable portion of the species. The stems in the greater number are creeping, and not unfrequently clothed at the base with a reddish down; in the arbusculoid section they are erect. The leaves are sometimes exactly distichous, in almost every instance more or less bifarious, and forming compressed or complanated branches; their structure is generally highly vascular, or in other words, loosely cellular and pellucid, on which account many are aptly compared to *Jungermanniæ*. The margin is occasionally thickened, with or without serratures, the base sometimes oblique; the nerve rarely reaches to the point, is at times bipartite, but more frequently double, the two being distant from each other, sometimes wholly wanting. The fruitstalks are mostly elongated; but in H. *concinna* and *pennata* they are short; smooth, or scabrous, or even scaly, as in H. *cristata*. The capsule, which often occurs reticulated,* is rarely erect, sometimes inclined, but mostly drooping, and that in consequence of the curvature of the upper extremity of the seta, the capsule itself not being oblique or arcuate in the slightest degree; this circumstance we esteem to be a remarkable feature in the capsule of this genus. The beak of the operculum, too, although often much elongated, is equally straight in its direction. The form of the calyptra is almost as variable as that of the genus *Orthotrichum*, being sometimes quite entire at the margin, sometimes cleft into a few short and

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* We believe it will be found, that in those species of *Hookeria* which have the leaves most decidedly cellular, the capsule and calyptra are most strikingly reticulated; the reticulation being only caused by the enlargement of the cellules, as in *H. cristata* and *lucens*. In other species, we do not find the calyptra and capsule to be reticulated; hence we do not consider that mark as being of sufficient consequence to form a generic distinction.

broad laciniæ, at other times into long narrow filiform segments, as in *Hookeria cristata* and *scabriseta*. The surface is never furrowed, but occasionally pitted and distinctly cellular, either glabrous, hairy, or hispid with short thick processes.

With regard to station, the *Hookeriæ* grow on the ground and on the trunks and branches of trees. Some inhabit the tropics, others are peculiar to the southern hemisphere, two only are found in Europe, one of which reaches to very high northern latitudes.

The excellent Schwaegrichen, treading in the steps of his illustrious predecessor Hedwig, discards the calyptra in the formation of his generic characters of mosses, and hence will not allow the *Hookeria* of Smith to be a valid genus; and in the 2d volume of his Supplement, he has given the name *Hookeria* to a genus of mosses, which Hooker himself had previously published in Brande's *Journal of Science*, under the appellation of *Tayloria*.

One species of this genus, *Hookeria pennata*, was so long ago as the year 1805 published by P. de Beauvois in his *Prodrome de l'Æthéogamie*, under the name of *Cyathophorum pteridioides*, but with a character so loose and imperfect, and a name so inexpressive, that no author seems to have adopted it; and it was unquestionably intended solely for the plant in question. We might say the same of this author's genus, *Racopilum*, which he designed should embrace our *H. depressa*, and the *Hypnum tomentosum* of Hedwig. To it he assigns the character of a calyptra cleft on one side; but with somewhat more propriety, Bridel only places the single species *H. tomentosum*, in this genus.

In the *Methodus Muscorum*, published in 1819, Bridel has formed a genus *Chætephora*, from Smith's *H. cristata*, the character resting mainly upon the filamentous calyptra.

Lastly, we may observe, that in the work just quoted, its author has also invented the genus *Pterygophyllum*, which he expressly states to be the *Hookeria* of Smith, and the *Cyathophorum* of Beauvois, differing from *Chætephora* solely in its glabrous calyptra. He has made the number of its species fifteen, but of these he mentions two as but doubtfully belonging to that genus, whilst three others, *P. struthiopteris*, *asplenioides*, and *jungermannoides*, are taken up from imperfect specimens, of which no fructification has been seen.

In essential characters, the genus which is most allied to *Hookeria*, is undoubtedly *Daltonia* of the *Muscologia Britannica*. This includes *Cryphæa* of Weber and Mohr, and some species of *Pilotrichum* of Beauvois, and has ciliary processes alternating with the teeth, not united at the base by a distinct portion of the membrane. According to our views of the genus *Daltonia*, it will contain, besides *D. splachnoides* and *heteromalla*, several beautiful individuals, which have been hitherto united with *Neckera*, and which we hope shortly to be able to enumerate.

A. *Foliis uniformibus undique insertis: seu* EXSTIPULATÆ.*

(*Fere omnibus caulibus procumbentibus ramosis.*)

* *Foliis enervibus, vel obsoletissime basi binervibus.*

1. Hookeria *lucens*, complanata, foliis bifariis, late ovatis obtusis integerrimis reticulatis enervibus, capsula ovata horizontali, calyptra integra impresso-punctata.

H. lucens, Smith in Linn. Trans. v. 9. p. 276. Engl. Bot. t. 1902. Hooker and Tayl. Musc. Brit. p. 89. t. 27. Hobson's Musc. Brit. v. 1.

Hypnum lucens, Linn. Sp. Pl. p. 1589. Hedw. Sp. Musc. p. 243. Turner Musc. Hib. p. 155. Moug. et Nestl. St. Crypt. No. 40.

Leskea lucens, Schwaegr. Suppl. v. 2. p. 164. t. 84. Funck. Deutsch. Moos. p. 54. t. 35.

Pteryophyllum lucens, Brid. Meth. Musc. p. 149.

HAB. Moist subalpine banks, Europe. West Coast of N. America, *A. Menzies, Esq.* This beautiful and well-known moss has a near affinity to the following species, with which it agrees in its very pale whitish-green colour, and exceedingly lax reticulation.

2. H. *acutifolia*, foliis bifariis ovatis acutis enervibus reticulatis, capsula ovata horizontali, calyptra impresso-punctata. PL. V.

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* For the sake of convenience, (the terms not being strictly correct,) we here employ the expressions *stipulate* and *exstipulate*. In the former of these divisions, the larger leaves are regularly distichous, and inserted on two opposite sides of the stems. There exist likewise intermediate leaves, sometimes forming a single, sometimes a double row, always different in figure, and considerably smaller than the lateral ones. These we have denominated stipules, although they are free from any attachment to the larger leaves, and only correspond to what are termed the stipules of *Jungermanniæ*. In the latter division, no leaves of this kind exist.

HAB. Nepaul, *Dr. Wallich.*

Similar in size and habit to *H. lucens*, which it also resembles in the horizontal dark-coloured capsule and pale entire and reticulated calyptra. Its acute leaves, however, constitute a remarkable point of difference between the two species.

3. H. *prælonga*, "caule pinnatim ramoso laxe folioso, foliis distichis subrotundis acuminatis integerrimis enervibus." *Arnott.* PL. V.

H. prolonga. Arnott in Wern. Trans. v. 5. p. 203.

HAB. Near Rio Janeiro. *Mr. Jameson.*

The stems of this species are two or three inches in length, pinnated with small ramuli three or four lines long; the leaves of the ramuli are ovato-lanceolate. Its fructification is unknown.

4. H. *flavescens*, caule vage pinnatim ramoso, ramis brevibus simpliciusculis subcompressis, foliis undique laxe imbricatis ovato-acuminatis integris enervibus perichætialibus lanceolato-acuminatis, capsula nutante, calyptra basi multifida.

HAB. Demerara. *C. S. Parker, Esq.*

Stems creeping, irregularly pinnated with short branches. Leaves pale yellow green, the lower ones inclining to brown, shortly, but very sharply acuminated, entire, nerveless, somewhat reticulated, and of a thin and membranaceous texture.—PL. V. fig. 1. Cauline leaf; 2. perichætial leaf.

** *Foliis uninervibus.*

5. H. *microcarpa*, caule simpliciusculo, foliis patentibus, late obovatis obtusissimis integerrimis immarginatis succulentis opacis medio diaphano laxe reticulato, nervo infra apicem evanescente "capsula erecta urceolata exigua."

Hypnum microcarpon, Hedw. Sp. Musc. p. 244. t. 59. Schwaegr. Suppl. 2. p. 197.

Pterygophyllum microcarpon, Brid. Meth. Musc. p. 149.

HAB. South Sea islands.

We only possess specimens of this moss without fructification from Mr. Dickson. The habit and structure of its leaves are quite peculiar, though at first sight it bears some resemblance in the former particular to *H. cristata.*

6. H. *Dicksoni*, subcompressa, foliis late ovatis acuminulatis tenuissimis pellucidis marginatis subundulatis integerrimis pulcherrimo-reticulatis, nervo ultra medium evanescente, capsula nutante, calyptra, basi (ut videtur) laciniata. PL. V.

HAB. .... Received from *Mr. Dickson.*

Of this plant we have only one small specimen, but it is sufficient to afford satisfactory characters for a very distinct species. In habit it comes near to *H. depressa*, but differs in the peculiar form and structure of its leaf, which, under the microscope, is extremely beautiful, with delicate roundish reticulations.

7. H. *radiculosa*, repens compressa subtus radicans supra foliosa, foliis ovatis subacuminatis integerrimis immarginatis, nervo ultra medium evanescente, capsula ovata nutante, operculo rostro curvato, calyptra basi integra.

H. radiculosa, Hooker, Musc. Exot. t. 51. Humb. et Kunth. Syn. Pl. v. i. p. 59.

HAB. Moist shady banks, near Caripe, S. America, at an elevation of 2680 feet, *Humboldt*. Orinoco, *Herb. Willd. Hornsch. in litt.*

*** *Foliis binervibus.*

† *Foliis integerrimis.*

8. H. *pendula*, ramis pinnatis curvatis compressis, foliis undique imbricatis ovatis basi binervibus, capsula pendula, operculo conico-rostrato, calyptra carnosa pilosa basi fimbriata.

H. pendula. Hooker, Musc. Exot. t. 53. Humb. et Kunth. Syn. Pl. v. 1. p. 60.

HAB. In temperate regions upon the mountains of the Andes. *Humboldt.*

A long straggling plant, with somewhat bipinnate compressed branches. Its capsule is oblong-ovate, and drooping; the calyptra laciniated at the base, and hairy like that of many *Orthotricha*. The perichetial leaves have a remarkably long acumination, and are slightly serrated.

9. H. *diaphana*, ramis paucis laxissime foliosis, foliis patentibus oblique late obovatis attenuato-acuminatis immarginatis integerrimis laxissime reticulatis pellucidis nervis duobus obscuris versus medium evanescentibus.

Hypnum diaphanum. Swartz, Prod. p. 140. Fl. Ind. Occ. p. 1828. Hedw. Sp. Musc. p. 243. t. 61. f. 1-6. (the magnified portions very incorrect.) Schwaegr. Suppl. 2. p. 193.

Pterygophyllum diaphanum. Brid. Meth. Musc. p. 150.

HAB. Island of Jamaica. *Swartz.*

This species is remarkable for having the leaves very thin and pellucid. Their apex we find to be always twisted. The fruit of this plant being unknown, it is from its general habit and the structure of its foliage that we are induced to place it in this genus.

10. H. *pallescens*, ramis compressis, foliis undique imbrica-

tis ovatis obtusis minute reticulatis basi binervibus, seta elongata, capsula subovata, calyptra multifida.

H. pallescens, Hooker, Musc. Exot. t. 28. Humb. et Kunth. Syn. Pl. v. 1. p. 60.

Hab. On the banks of the Orinoco, in shady places, near Esmerelda. *Humboldt.*

11. H. *filiformis*, ramis tenuibus, foliis undique imbricatis vel subsecundis ellipticis integerrimis arcte reticulatis, nervis duobus pellucidis fere ad apicem attingentibus apice longe attenuato filiformi flexuoso. Pl. V.

Hab. Island of Guadaloupe.

Unfortunately our specimens of this plant are without fructification. They were communicated by Professor Sprengel, under the name of *Hypnum Boscii*. Its leaves are strikingly different from those of any other species which we are acquainted with.

†† *Foliis versus apicem serratis.*

+ *Capsula suberecta.*

12. H. *scabriseta*, caule subpinnatim ramoso compresso, foliis undique imbricatis, late ovatis subacuminulatis, seta scabra, calyptra longe laciniata subhispida.

H. scabriseta. Hooker, Musc. Exot. t. 52. Humb. et Kunth. Syn. Pl. v. 1. p. 59.

Hab. Moist rocky places near Caripe. *Humboldt.*

This species is remarkable for the roughness of its fruitstalk, and the great length of the segments of its calyptra. The perfect fruit we have not seen.

13. H. *leptorhynca*, caule repente cæspitoso vage ramoso, ramis brevibus, foliis laxe imbricatis ovato-lanceolatis acuminatis apice serrulatis nervis duobus infra apicem evanescentibus, capsula cylindrica, operculo subulato, calyptra sexfida glabra. Pl. V.

Hab. Island of St. Vincent's, *Rev. L. Guilding.*

A small, but extremely beautiful species, with loosely reticulated leaves, their nerves long and very strong, the capsule nearly erect, and, what we consider a remarkable circumstance, having a calyptra, which, though decidedly campanulate, does not cover more than one half of the capsule.

+ + *Capsula nutante, vel pendula.*

14. H. *cristata*, caule erecto ramoso, foliis obovatis margi-

natis succulentis reticulatis basi nervo bipartito, seta arcuato-curvata apice cristata, capsula pyriformi cernua, calyptra multifida. PL. V.

Leskea cristata, Hedw. Sp. Musc. p. 211. t. 49. Schwaegr. Suppl. II. p. 159.

Chætephora cristata, Brid. Meth. Musc. p. 149.

HAB. South Sea islands, where we believe it was first found by *Mr. Forster,* during the celebrated voyage round the world with Captain Cook. Isle of France, *Aubert du Petit Thouars.*

This species is very remarkable for the curvature of its fruitstalk, which is bent down at the top like the neck of a swan, and at that part is beautifully crested with membranaceous scales. These scales exist, though of a smaller size, and regularly imbricated, upon all the rest of the seta, which is of a succulent nature, much resembling that of a *Sphagnum,* and swelling out into a small bulbous base. The substance of the leaves is remarkably succulent, that of the perichætial ones membranaceous, nerveless, and ending in a long acumen. The capsule is rich brown, and beautifully reticulated; the lid we have not seen. The calyptra is large, companulate, whitish, rigidly membranaceous, multifid at the base in the same manner as that of *Daltonia splachnoides;* its segments very narrow, pellucid and rigid, resembling, when highly magnified, the quill portion of a feather, its upper part is hispid. Some specimens which we have received from the Isle of France, of a *Hookeria* without frutification, seem exactly to coincide with the character of this species. The plant which Bridel has called Pterygophyllum asplenioides, and which was sent to him from the Isle of Bourbon, appears also to be *H. cristata.*

15. H. *Parkeriana,* caule elongato, ramis complanatis, foliis imbricatis subbifariis oblongis acutis undulatis apice serrulatis nervis duobus fere ad apicem attingentibus, capsula oblonga horizontali, calyptra laciniata. PL. V.

HAB. Upon trees in Demerara, *C. S. Parker, Esq.*

This noble moss, which in its habit much resembles *Neckera crispa,* especially in the form, size, and disposition of its foliage, we have named after its discoverer, our excellent friend C. S. Parker, Esq. of Blochairn, near Glasgow. The stems creep to a great length, and are bare of leaves; the branches are irregularly pinnated, two or three inches long, and, including the leaves, a quarter of an inch broad. The fruitstalks are numerous, about an inch and a half long; the capsule oblongo-pyriform, horizontal; the calyptra quite glabrous.

16. H. *undata,* compressa, foliis imbricatis ovato-lanceolatis longe acuminatis versus apicem undulato-crispatis serratisque, nervis duobus ultra medium evanescentibus, "capsula ovata, operculo longe conico." PL. V.

Leskea undata. Hedw. Sp. Musc. p. 214. t. 52. Schwaegr. Suppl. II. 165.

Hypnum Guadalupense, Schwaegr. Suppl. II. p. 189.

Pterygophyllum undatum, Brid. Meth. Musc. p. 149.

Hab. Jamaica, communicated to Hedwig by *Swartz.*

As far as we can judge from the descriptions given by Bridel and Schwaegrichen of *Hypnum Guadalupense*, that plant does not differ from the present individual; an opinion in which we are supported by Mr. Arnott.

17. H. *lætevirens*, complanata vage pinnatim ramosa, foliis bifariis ovatis acuminulatis marginatis apice subserrulatis usque ad apicem fere binervibus, capsula ovata horizontali, operculo conico-rostrato, calyptra integra.

H. lætevirens, Hooker and Tayl. Musc. Brit. p. 89. t. 27.

Hab. In a bog near Cork, Ireland, *Mr. Drummond.*

An exceedingly beautiful species, of a full bright shining green colour, two inches or more in length. The capsule and calyptra are very similar to those of *H. lucens* and *acutifolia.* It has never been found in any station except the one above given.

18. H. *Langsdorfii*, elongata ramosa, foliis distichis compressis ovatis subacuminatis apice serratis, nervis duobus ante apicem evanescentibus, capsula ovata nutante, operculo hemisphærico rostrato, calyptra basi sexfida.

H. Langsdorfii. Hooker, Musc. Exot. t. 121.

Hab. Near Rio Janeiro, *Langsdorff*; communicated by *Mr. Swainson.*

A fine species, nearly five inches in length, and resembling in its general habit both *H. albicans* and *H. lætevirens.*

19. H. *albicans*, ramis complanatis, foliis bifariis ovatis apiculatis summitate serratis pellucidis laxe reticulatis nervis duobus divergentibus infra apicem evanescentibus, capsula nutante ovata, operculo acuminato, calyptra basi laciniata.

Leskea albicans, Hedwig, Sp. Musc. p. 218. t. 54. f. 13—16. Schwaegr. Suppl. II. p. 162. Swartz. Fl. Ind. Occ. p. 1811.

Hypnum albicans, Swartz, Prod. p. 140.

Racopilum Aubertii. Pal. de Beauv. Æthéog. Prodr. p. 37.

Pterygophyllum albicans, Brid. Meth. Musc. p. 150.

Hab. Jamaica, Swartz. St. Vincent's, *Rev. L. Guilding.*

In general appearance this comes near to *H. lætevirens*, but its leaves have a much more lax reticulation, and are very pellucid; the capsule, moreover, is not horizontal, nor its calyptra entire.

Bridel, under *P. albicans*, quotes *Neckera Aubertii* of his *Sp. Musco-*

rum, v. 2. p. 28; and also his *Hypnum vesiculosum, Sp. Musc.* v. 2. p. 100.

20. H. *incurva*, foliis bifariis obovatis subacinaciformibus obtusis denticulatis ultra medium binervibus reticulatis, perichætialibus cordato-acuminatis, capsula ovata nutante, calyptra basi laciniata.

Chætephora incurva, Hornsch. in Horæ Phys. Berol. p. 65. t. 13.

Hab. Chili, *Chamisso*.

A very beautiful and distinct species, well figured by Hornschuch in the work above mentioned. We find the denticulations to be of a very peculiar structure, evidently formed of cellules similar to those of the rest of the leaf, sharpened, very acute, and placed with great regularity upon the otherwise even margin of the leaf.

21. H. *depressa*, ramis subcomplanatis, foliis laxe imbricatis oblongis breviter acuminulatis apice serrulatis, nervis duobus infra apicem evanescentibus siccitati crispatis, capsula ovata nutante, operculo conico acuto, calyptra basi breviter laciniata.

Hypnum depressum, Swartz, Prodr. p. 141.

Leskea depressa, Brid. Meth. Musc. p. 144. Swartz Fl. Ind. Occ. p. 1804. Hedw. Sp. Musc. p. 215. t. 53. Schwaegr. Suppl. II. p. 166.

H. affinis, Arnott, in Wern. Trans. v. 5. p. 202.

Hab. Jamaica, *Swartz*. St. Vincent's, *Rev. L. Guilding*. St. Domingo, *Thuill.* Guadaloupe, *Sprengel.* Garrow Hills, E. Indies, *Dr. Wallich.*

22. H. *falcata*, foliis falcato-secundis lanceolatis longe acuminatis serratis binervibus, capsula ovata horizontali, operculo subulato, calyptra basi sex- vel octo-fida.

H. falcata Hooker, Musc. Exot. t. 54.

Hab. In valleys of the Andes, between Almaguer and Pasto, *Humboldt.*

Remarkable for its falcato-secund and much acuminated leaves. The calyptra is cleft into broad segments, and is scabrous at the apex.

23. H. *repens*, ramis compressis sericeis, foliis subfalcato-secundis imbricatis bifariis ovato-lanceolatis attenuatis reticulatis versus apicem dentato-serratis obsoletissime binervibus, capsula exigua horizontali, calyptra integra. Pl. V.

Hab. St. Vincents, *Rev. L. Guilding*.

A small creeping species, with delicate foliage. The leaves are falcato-secund, especially towards the extremities of the branches. The fruitstalk is extremely slender, with a narrow and oblong capsule, the calyptra glabrous and entire at the base.

B. *Foliis tri-quadrifariam insertis (anterioribus minoribus)*; *seu*

STIPULATÆ.

* *Caulibus vix ramosis.*

24. H. *pennata*, caule erecto simplici, foliis bifariis verticalibus ovato-lanceolatis serratis enervibus, stipulis orbiculatis mucronulatis serratis, seta brevi, capsula ovata erecta.

H. pennata, Smith in Linn. Trans. v. 9. p. 277. Hooker, Musc. Exot. t. 163.

Pterygophyllum pennatum, Brid. Meth. Musc. p. 149.

Cyathophorum pteridioides, Beauv. Æth. p. 52.

Leskea pennata, Labill. Nov. Holl. v. 2. p. 206. t. 253. Schwaegr. Suppl. II. p. 160.

Anictangium bulbosum, Hedw. Sp. Musc. p. 44. t. 6. f. 1—5.

HAB. New Holland, *Labillardière*. Dusky Bay, New Zealand, *A. Menzies, Esq.* Van Diemen's Land, *R. Brown, Esq.*

Of this noble moss we have received specimens from Mr. Brown, which measure 5 or 6 inches in height, and bear fructification in every period of growth. The calyptra is, as Mr. Brown first ascertained, entire, campanulate, and tipped at the extremity with the persistent style.

25. H. *quadrifaria*, caule erecto subramoso, foliis quadrifariis reticulatis medio uninervibus, lateralibus distichis verticalibus ovatis, intermediis (seu stipulis) subrotundis erectis appressis, capsula subcylindracea pendula.

H. quadrifaria, Smith in Linn. Trans. v. 9. p. 277. t. 31. f. 1. Hooker, Musc. Exot. p. 109.

Pterygophyllum quadrifarium. Brid. Meth. Musc. p. 151.

HAB. In Dusky Bay, New Zealand, *A. Menzies, Esq.* 1791.

One of the finest species in this genus, nearly 4 inches in length; and from its extremely succulent nature bearing a strong resemblance to a *Jungermannia*.

** *Caulibus apice valde ramosis arbusculoideis.*

26. H. *concinna*, caule erecto bipinnato inferne nudo, foliis bifariis verticalibus stipulisque oblongis brevi-acuminatis apice serratis, nervo attingente; seta brevi, capsula erecta, operculo subulato.

Leskea concinna. Hooker, Musc. Exot. t. 34.

HAB. In Dusky Bay, New Zealand, *A. Menzies, Esq.* Van Diemen's Land, *Dr. Spence.*

We are ignorant of the calyptra of this beautiful species, but have referred it to this place, on account of the affinity of its habit, leaves, and stipules, with those of *H. rotulata* and its allies.

27. H. *filiculiformis*, "ramis fasciculatis tripinnatis, foliis ovatis trifariis complanatis integerrimis enervibus, intermediis (seu stipulis) parum minoribus." Smith.

H. filiculiformis, Smith in Linn. Trans. v. 9. p. 278.

Leskea filiculiformis, Hedw. Sp. Musc. p. 212. t. 50. Schwaegr. Suppl. II. p. 259.

Pterygophyllum filiculiforme, Brid. Meth. Musc. p. 151.

HAB. South Sea Islands.

With this species we are unacquainted. The stems, according to Hedwig's figure, are four or five inches high, and much branched at their upper extremity, in a tripinnate manner; the leaves and stipules are destitute of nerves.

28. H. *rotulata*, caule apice pinnatim ramoso, foliis bifariis oblique ovato-acutis marginatis grosse denticulato-serratis nervo supra medium evanescente, stipulis duplo minoribus rotundatis apiculatis marginatis serratis integerrimisve nervo excurrente, capsula nutante ovata, operculo longe rostrato.

α. *Ramis compactis subfaciculatis, foliis strictioribus perichætialibus oblongo-lanceolatis acuminatis, stipulis minoribus.*

H. rotulata, Smith in Linn. Trans. v. 9. p. 279.

Leskea rotulata, Hedw. Sp. Musc. p. 213. t. 51. Schwaegr. Suppl. II. p. 159.

Pterygophyllum rotulatum, Brid. Meth. Musc. p. 151.

β. *ramis laxe pinnato-fasciculatis, foliis subundulatis stipulis majoribus perichætialibus late ovatis magis concavis, breviter attenuatis.*

H. tamariscina, Smith in Linn. Trans. v. 9. p. 279. ?

Hypnum tamarisci, Swartz, Prodr. p. 141. Fl. Ind. Occ. p. 1825.

HAB. α South Sea Islands, *Hedwig*. New Zealand, *A. Menzies, Esq.* —β. Jamaica, *Swartz*. Nepaul, *Dr. Wallich*. Rio Janeiro, *Dr. Langsdorff*. Cape of Good Hope, *A. Menzies, Esq. (Smith.)*

In its general appearance this plant is liable to considerable variation; our New Zealand specimens have the branches densely fasciculated, as Hedwig's figure well represents; those from Nepaul are more loosely branched, whilst in some from Jamaica the main ramifications are considerably elongated, and the pinnæ distantly placed. In our first variety, the perichætial leaves are more erect, narrower, almost plane, and of a somewhat compactly membranaceous texture; whilst both in East and West Indian specimens of the variety β, the perichetial leaves are scarcely half so long, much more concave, and suddenly lengthened into a very narrow point. Their reticulation also is considerably looser.

We find great confusion to exist in what regards the two species of this genus, which have been published by Swartz and Hedwig, under the names of *Leskea tamariscina* and *L. rotulata*. The appellation *tamariscina*, (or rather *Tamarisci*, as Swartz has it,) was first established by that author upon a Jamaica plant, which we have clearly ascertained from his own specimens, as well as description, to be synonymous with the *L. rotulata* of Hedwig. On the other hand, Hedwig, taking his representation and account from an Australasian plant, which had been given him, we suspect, by Dickson, has a totally different species. By right of priority, therefore, the name of *Tamarisci* should be applied to *L. rotulata*. But we consider the Hedwigian *tamariscina* to be so well established, and so generally known by the excellent figure given in the *Species Muscorum*, that the general adoption of it will prevent confusion. Sir J. E. Smith, under his *H. tamariscina*, has included Swartz's Jamaica plant, and another species allied to it from the Cape of Good Hope, which we shall presently have occasion to describe; and he seems to us to have made his description from the West Indian individual, which is our *H. rotulata*; but he has referred to the plate of the Hedwigian *tamariscina*. Our valued friend is, therefore, strictly correct in regard to the name; and he has made the observation, that he was unable to discover the bristles mentioned by Hedwig, which only belong to *H. tamariscina*.

29. H. *tamariscina*, foliis bifariis oblique ovatis marginibus denticulatis nervo infra apicem evanescente, stipulis ovato-acuminatis marginatis laciniato-serratis, processibus setaceis in axillis foliorum, "capsulis ovatis pendulis." *Hedw.*

Leskea tamariscina, Hedw. Sp. Musc. p. 212. t. 51.

Hypnum Tamarisci, Schwaegr. Suppl. v. 2. p. 182. (but not H. Tamarisci of Swartz, nor Hookeria tamariscina of Smith.)

Pterygophyllum Tamarisci, Brid. Meth. Musc. p. 151.

Hab. South Sea Islands, received from *Mr. Dickson*.

This most remarkable species, as far as our observation extends, constantly possesses the axillary setaceous processes described and figured by Hedwig. These may probably be regarded in the light of abortive leaves, of which the nerve alone has been developed.

We have endeavoured to clear up the obscurity in which the present and the last-mentioned species have been involved, in our description of *H. rotulata*, and we have there stated our reasons for retaining their present appellations.

30. H. *laricina*, caule erecto inferne denudato, apice pinnatim ramoso, foliis oblique ovatis submarginatis denticulatis basi uninervibus, stipulis cordatis breviter acuminatis serratis nervo perbrevi, capsula ovata nutante, operculo rostro curvato.

H. laricina, Hooker, Musc. Exot. t. 35.

Hypnum laricinum, Humb. et Kunth. Syn. Pl. v. 1. p. 62.

Hab. Cape of Good Hope, *A. Menzies, Esq.* Mountains of the Andes, *Humboldt*.

The nearest affinity of this species is with *H. rotulata,* but it differs in its leaves being softer, scarcely at all margined, and with a short nerve, whilst the stipules have hardly any nerve at all. There is also a decided, but very short nerve in the perichetial leaves.

SPECIES DUBIÆ.

31. Hypnum *rigidum,* (Schwaegr. Suppl. II. p. 189,) " erectum, apice ramosum, foliis subdistichis remotis ovatis acutis binervibus serratis." *Schwaegr.*

Pterygophyllum rigidum, Brid. Meth. Musc. p. 150.

HAB. Supposed to be a native of South America.

Mr. Arnott seems to be of opinion that this may prove the same with *Hookeria scabriseta;* but its fructification being unknown, we cannot speak with certainty. The author compares it with *H. albicans.*

32. Hypnum *duplicatum,* (Schwaegr. Suppl. II. p. 198.) " repens, ramis simplicissimis, foliis bifariam imbricatis oblongis acutis basi semiduplicatis enervibus integerrimis." *Schwaegr.*

HAB. In the Isle of Bourbon.

The fruit of this species also has not been discovered. Schwaegrichen observes, that it strongly resembles *H. diaphanum,* (our *Hookeria diaphana.*)

33. Hypnum *splachnifolium,* (Aubert; Brid. Suppl. Musc. 2. p. 101.) " repens, subramosum, foliis bifariam imbricatis lanceolato-subulatis longissime reticulatis, operculo longirostri." Schwaegr. Suppl. 2. p. 193.

Pterygophyllum ? splachnifolium, Brid. Meth. Musc. p. 150.

HAB. ....

The calyptra of this moss is unknown.

34. Pterygophyllum *jungermannoides* (Brid. Meth. Musc. p. 152.) " caule repente basi erecto simpliciter pinnato, foliis remotis distichis oblique ovato-cuspidatis serrulatis nervo evanido siccitate undulato-rugosis, teguminibus unius seriei appressis cordato-acuminatis." *Brid.*

HAB. New Holland, *Desfontaines.*

This moss, of which no fructification has been discovered, seems nearly allied to *Hookeria laricina* and *rotulata.*

35. Hookeria *flabellata,* (Smith in Linn. Trans. v. ix. p. 280.) " caule erecto, ramis sparsis pinnatis, foliis distichis complanatis, apice serratis." *Smith.*

Hab. West Indies, according to Mr. Dickson.

This plant, although it has the same habit as the arbusculoid *Hookeriæ,* yet possesses no stipules, and has a seta scarcely longer than the perichætial leaves; circumstances which, viewed conjunctly with its other characters, bring this moss so exceedingly near to *Neckera dendroides* of *Musci Exotici,* that we are much disposed to look upon them as the same.

Art. X.—*On the Distribution of Granite and of Trap in different Parts of Scotland.* By John MacCulloch, M.D. F.R.S. F.L.S. and M.G.S. Chemist to the Board of Ordnance, and Professor of Chemistry in Addiscombe College. Communicated by the Author.

The circumstances in the distribution of granite and of trap, which form the object of this paper, are not only interesting in a geological view, but especially deserve the attention of such practical geologists as may be engaged in forming geological maps of those parts of the country where they occur. To treat of them as fully as they deserve, from their importance in both these respects, would require that which is here inadmissible, namely, a geological map of the districts in question, as well as a length of discussion far too great for the present purposes, and which could not indeed well be made intelligible without a very extensive geographical description of the tracts where these appearances are found.

Although granite exists in many parts of Scotland in continuous tracts of very considerable extent, as in Galloway, in Lorn, in Sutherland, in Perthshire, and in Aberdeenshire; it is often also found occupying very small spaces, and sometimes in very unexpected situations. In Aberdeenshire, this occurrence is very common: but it is not there a matter of surprise, when the peculiar circumstances attending the stratified rocks of that district are considered. It is easy to perceive that the gneiss, which constitutes the chief of these, has been destroyed over a great extent of surface, and to a considerable depth; the earth, and fragments produced from its destruction, sometimes remaining in the form of alluvial soil, forming deep beds; and being, in other places, carried away by the usual causes which transport loose materials along the surface.

Hence the granite appears at the surface in a very irregular manner, and often very unexpectedly. In these cases it has no relation to the form or altitude of the place where it occurs; since it is found in the lowest as well as the highest situations; in both of which also, the gneiss appears in the same uncertain manner. In many places it will thus happen that a patch of granite may not occupy an extent of more than a few yards, or perhaps a few hundreds; and cases of this nature occur in every part of that granitic district.

To the geologist who is anxious to lay down a district of this nature in a map, this circumstance is a source of great labour; requiring all his care and industry, and demanding, indeed, a degree of toil which is almost incomprehensible. Here, also, the difficulty is not limited to the granite only; affecting the stratified rocks nearly in an equal degree. Where strata present a considerable continuity over any tract of country, it is almost always easy to infer the existence of large portions of them without actual examination; by the comparison of bearings and dips, and by general inferences respecting their necessary connection or prolongation. But where they are found forming masses so thin as barely to cover the subjacent granite, not only their dips and bearings are irregular and uncertain, but the frequent interruption to which they are exposed by the intruding granite, renders it impossible to prolong them, or infer their existence in any particular spot without actual examination. Thus they become as difficult of investigation as the granite itself, in which the want of stratification precludes all species of investigation, but that which proceeds on the basis of actual and manual examination.

In Aberdeenshire, other causes tend materially to increase the labour of the geological surveyor. The quantity of alluvial matter arising from the decomposed gneiss is such, as often to cover all the rocks to a great depth; so that it is only from the most casual appearances, in the bed of a rivulet, a quarry, or the side of a road, that we are enabled to discover whether gneiss or granite is present, or whether some other of

Hab. West Indies, according to Mr. Dickson.
This plant, although it has the same habit
riæ, yet possesses no stipules, and has
perichætial leaves; circumstances
other characters, bring this
droides of *Musci Exotici*,
as the same.

Art. X.—*On*
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[illegible] Nor does [illegible] as the same con- [illegible] pervades both classes of [illegible] surveyor must every where [illegible] the ground which he is ex- [illegible] manner, successive trials, and much [illegible] is it still after many [illegible] that he is enabled to trace the boundaries of the several rocks as they appear at the surface. This, however, is a necessary part of his duty. It is to little purpose, whether for the objects of science or economy, to construct a map in which, instead of observations correctly localized, general features are expressed. Nothing useful can be drawn from a survey of this nature, while the practice is attended with the further evil of encouraging a hasty mode of concluding, instead of examining; and thus of substituting prejudices for facts, and fiction for truth.

The difficulties which attend the examination and discovery of small tracts of granite are, however, very much augmented, where it occurs in independent situations, and in a scattered manner, in districts of primary strata, where no extensive masses of it are present. Here it is impossible to conjecture where it is to be found, or where, after being once found, it is again to be expected. In these tracts it occurs indifferently in the lowest and in the highest situations; nor is it in general marked by any peculiarity of outline, or by any one circumstance indicating its existence. The observer only finds it at his feet, and cannot even always recognise it as certain, till he has detached a specimen. Thus, if he is desirous to gain a reputation for accuracy, or really to lay down the rocks that occur in any given district, he dares not omit even a square mile in his investigation, or even, in many cases, far less; but is obliged to traverse every spot where this rock, giving no data from which to infer its existence, may be found. It is, indeed, from the number of any such smaller masses of rock, whether of granite or others, found in any geological survey, that the accuracy of the observer may be conjectured. General details are in every one's power, but of such it may truly be said, in the ancient maxim, that "*dolus est generali-*

bus." They are too often the result of conjecture, instead of actual examination.

It will not be amiss to point out a very few of the places in Scotland where these unexpected masses of granite are found.

They occur both in districts of micaceous schist and of gneiss, and they are even found, in more than one place, in the middle of the old red sandstone.

In the gneiss district, on the west coast, from Morven northward, they are very common, as they are in the central parts of Inverness and Ross-shire. About the sources of the Spey and the Findhorn, such small masses abound often not exceeding many square yards in dimensions. Even in Rannoch such masses are found in a district of micaceous schist, and removed by many miles from any other similar rock. It is unnecessary to multiply examples; and it would be equally unnecessary to offer this caution to any geologist, who has accurately examined these tracts, as he cannot fail to have met with instances of this occurrence.

The chief difficulty of investigating granite, arising from its want of stratification, is an equal source of toil in the examination of the trap-rocks. These also abound in Scotland; and, like granite, they are found, in some places, in large extensive continuous tracts, in others, scattered in very minute patches, and separated by wide intervals.

To connect these separated portions requires a different view from that by which we attempt to reunite the scattered masses of granite. These latter are judged, from all experience, to be actually, and at present, continuous beneath the superficial or incumbent strata. Trap lies above the stratified rocks; and, when discontinuous, it is so, either because it has been originally deposited in that manner, or because the larger masses, once continuous, have been destroyed in particular spots so as to lose their continuity. Both of these are the consequences of interesting geological causes which are not the objects of consideration here. The fact alone is the subject of the present discussion.

Although trap is unstratified, it often possesses a peculiar aspect, either in its outline, or in the nature of its vegetating surface, when compared with the surrounding country, by which it may be known even at a distance; and thus the geologist may escape a considerable degree of the labour of minute investigation. But these features are by no means universal; nor is it often possible to form the slightest conjecture respecting the presence of these rocks except by careful manual investigation. For example, it does not always occupy the hills, or even the insulated summits, when it occurs in sandstone countries. On the contrary, it is by no means unusual for the trap to be found in the lowest parts of such a country, while the sandstone occupies the highest; and, of this, Fife presents abundant examples. Neither is it unusual for the stratified rocks to assume the external outline of trap, while this rock is totally void of characteristic features.

It is also usual in Scotland for trap to occur in connection with the secondary strata, and the particular tracts where it is most abundant are well known. There the investigation, at least of larger masses, is comparatively easy; because the substance is expected, and because the contrast which it presents to the sandstones to which it approximates is commonly very strongly marked. But it is found also in many places, and often in an insulated manner, in the primary districts, where, from previous general experience, it would scarcely be expected to exist. There also its general external characters are less strongly contrasted with those of the surrounding rocks, and thus it may escape the notice of a superficial or hasty observer.

These are the causes which not only render the investigation of a country of trap in itself difficult, but which produce equal difficulty in examining the stratified rocks of any district in which even one insulated mass of this rock has been found. The observer there loses all confidence in his power of inferring the existence of the stratified rocks in any place where he has not actually observed them, because he is never certain that some insulated mass of trap may not occur among them. Thus, as in the case of granite, every spot must be traversed and examined in a critical manner, if he would attain that accuracy without which a geological survey is scarcely of any value.

In countries of this structure also, as in the granitic districts of Aberdeenshire, a depth of alluvia sufficient to conceal effectually the subjacent rocks, is a perpetual source of obscurity and labour. Here, indeed, it commonly arises from a different cause, the alluvial covering being the produce of the decomposed trap itself, and proceeding from that cause which has produced the discontinuity of the larger masses, and insulated the detached spots and summits which abound in districts of this nature.

To quote examples of the fact now noticed, would be to enumerate nearly all those districts in Scotland where trap occurs. I shall satisfy myself with stating, in the most general manner, that they may be found in the whole central district of Scotland, which is included between the Highland mountain boundary and the schist of the south. Whoever may wish to make a map of this tract, as of many others in Scotland, may be assured that he will only succeed by examining nearly every square yard; and that, without this attention, he will only produce that which will be as useless for its intended purposes as discreditable to himself.

I need not prolong this subject, and shall be satisfied if these hints, the fruit of hard experience, shall be of use to those who may intend to labour in this department of geology, or to those who expect to profit by their labours.

ART. XI.—*Remarks on the Influence of the Winds on the Barometer.* Communicated by the Author.

ABOUT the beginning of the last century, Mr Hawskbee proposed the following experiment to explain the descent of the barometer during a storm. "Having connected the cisterns of two barometers by a horizontal pipe of three feet, he inserted in the side of one of them a pipe opening outwards, and connected the other side with a large receiver, into which three or four charges of atmosphere had been compressed; on opening the cock the air rushed with vehemence over the mercury in the cistern and effected its escape, while both columns fell simultaneously about two inches, and rose again as the force of the blast diminished;" from this experiment he derives four corollaries, the first two of which are, 1. "That we have here a clear and natural account of the descent and vibrations of the mercury during a storm." And, 2. "That not only the different forces, but also the different directions of the wind, are capable of producing a difference of subsidence of the mercury." Upon this Professor Leslie* remarks: "This experiment has a specious appearance, and might seem to warrant the conclusions drawn from it, but a closer examination dispels the illusion; since the air had been condensed four times, it must issue from the vessel with the velocity of 2700 feet in a second; this is a rapidity, however, twenty times greater than the most tremendous hurricane; the very small change of the 400dth part of an atmosphere would hence have been sufficient to produce the strongest wind ever known, and, therefore, its influence in passing over the mercurial column must have been quite insignificant. But the experiment itself is absolutely fallacious; the peculiar result proceeded from a casual circumstance, the exit-pipe being larger than the pipe which introduced the air; for the air being previously condensed, and still restrained in its passage through the induction pipe, on entering the cavity of the box, immediately expands beyond the limit of equilibrium, and finding an easy escape through the exit-pipe, allows that state of dilatation over the mercury during the time of the horizontal flow, but the air contained in the other cistern must, from its communication by the pipe, suffer a like expansion, and the columns will subside equally."

That this reasoning is also fallacious may, I think, be thus shown: That the air, even after its "dilatation" in its passage through the cistern, is still considerably denser than the surrounding air, (otherwise the blast would cease,) is beyond dispute; whence then the *fall* of the mercury? it should rather rise; this explanation is evidently inadequate. That the difference of size in the induction and exit pipes will *effect* the result is admitted, indeed, it is evident; and I am inclined to think, that, if in the above case, the blast had been equally swift and less confined, the result would have been more striking, and, therefore, that "the influence of the strongest wind ever known would *not* be quite insignificant." The Professor continues, "Such is unquestionably the true explication of the fact," and confirms it by this experiment:

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* Vide Suppl. Encycl. Brit. Art. Meteorology.

"Let A, Plate IV. Fig. 2. be any cylinder, suppose three inches long, and two in diameter, having an open pipe inserted at B, a quarter of an inch wide, and perhaps two inches long, and another at C about three-eighths or half an inch wide, and one inch long; at right angles to these a syphon GHF of one-tenth of an inch bore is cemented below containing coloured water. If a blast be injected into the cavity at B, the water will rise to G, showing the diminished pressure, and consequent rarefaction of the air above it; but if a cap D with a narrow pipe of perhaps one-eighth of an inch bore be adapted to C, on repeating the experiment, an opposite effect will take place, and the column of water will subside to H. It is evidently the difficulty of the escape through D which occasions the accumulation of air in the cylinder."

The reason given in the latter case is undoubtedly just, but not so in the former; for to produce a rarefaction of the air in the cylinder, it is necessary that more air should pass out through C than is injected at B, an incident which we cannot look for.

I will now show that the wind may partially remove or increase the vertical pressure according to its direction.

Let AB, Fig. 3. be any tube of equal bore, into the side of which the syphon CE containing coloured water, opens at an angle of about 30° with the tube AB; now, if a blast be sent through the tube from A to B, the column in C will fall, if from B to A, the column will rise, and even flow out through the tube AB, the latter result will take place, whatever the situation of the tube C, provided the blast does not take effect down the opening of C, for then the column will be depressed.

These latter proofs of the action of the wind were suggested by an article in a late number of the "*Mechanics' Magazine*," in which the writer says he raised water to the height of eight inches in a funnel by the blast of a pair of bellows directed over the mouth of it. I have since found the principle of much service in the use of a syphon, for by directing a blast from the mouth through a tube rather larger than the syphon, in a direction nearly parallel with the leg, the liquid is raised over the bend, and thus begins to flow without the inconvenient process of filling it as is usual. That the wind does diminish or augment the vertical pressure of the atmosphere sufficiently to account for the variations of the barometer I will not venture to assert; but a friend once told me, that he had found his barometer so unsteady whilst in a passage where there was a draught, that he was obliged to move it.

The learned Professor proposes a new theory of the variations of the barometer, the principle of which is, "That as a horizontal current of air must, from the form of the earth, continually deflect from its rectilineal course, such a deflection being of the same nature as a centrifugal force, must diminish the weight or pressure of the fluid." This may be sufficient to account for the fall of the barometer in high winds, but it necessarily ascribes the rise of it to a cause merely negative, viz., the absence of wind, yet the rise of the barometer in a north-east wind is often very considerable. On the other hand, if we consider the north wind as blowing downwards, (which we may perhaps do as coming from a colder region,) the fact accords with Mr Hawksbee's theory.

E. A.*

LONDON, *January* 27*th*, 1825.

ART. XII.—*On a New Formation of Anhydrous Sulphuric Acid.* Observed by C. G. GMELIN, Professor of Chemistry in the University of Tübingen. Communicated by the Author.

IT has been an opinion hitherto received, that anhydrous sulphuric acid can be obtained in no other way, than by decomposing in a distillatory apparatus such sulphates, as, when heated, give off their acid, such as calcined iron-vitriol. It is generally known, that the fuming oil of vitriol from Nordhausen is procured in this way. I have found, that the *not fuming* (so called in English) oil of vitriol yields at a certain period of the distillation fuming acid. I heated in a retort, connected with a receiver, 6 pounds 14½ ounces English oil of vitriol, of a specific gravity, = 1.8435 at + 10½° R. which was not the least fuming. The acid never came to boiling; the temperature of the air was 0° R. four ounces having distilled, having a strong smell of sulphurous acid, the receiver was emptied, cleansed, and applied anew. When eight ounces of an acid, which was quite destitute of smell, had distilled over, the receiver, which had hitherto been perfectly transparent, was suddenly filled with vapours. It was removed, and another dry receiver applied, which was now surrounded with powdered ice. There was condensed an acid partly not transparent, partly transparent and crystalline; a good deal of the solid acid was found in the neck of the retort. This solid acid was exceedingly fuming like that produced from the fuming oil of vitriol; it remained solid at + 12° R., and had no smell of sulphurous acid. When brought in contact with a certain quantity of sulphur, in a close air-tight glass vessel, a green compound, having the colour of muriate of chrome, was formed, and a little sulphurous acid was disengaged. This green mass being brought in contact with water, a very great heat was evolved, sulphurous acid formed, and sulphur dissolved. When the solid acid was brought in contact with water, diluted acid was formed, but no sulphurous acid. This diluted acid being saturated by potash, and evaporated to crystallization, no nitre was formed, nor were nitrous vapours produced by heating the dry mass with concentrated sulphuric acid. The specific gravity of the acid left in the retort, *which was now sensibly fuming*, was found = 1.8503 at + 13° R., the specific gravity of the acid which distilled over, = 1.4309 at + 11½° R.* This experiment being repeated with the same acid, the same result was obtained. But it may happen, that the moment at which the fuming acid is formed is overlooked; in the experiments just now mentioned, it was not formed, but in the first half of the third day, (during the two first days, from seven o'clock in the morning till nine o'clock in the evening, fire had been kept in the furnace,) and its formation could not longer be perceived than during about half an hour.[*] These experiments leave, I think, no doubt, that the solid acid really was anhydrous sulphuric acid. Its formation may thus be explained, that, in a certain concentration of the aqueous sulphuric acid, part of the acid yields its water to another part of the acid, and is volatilized, whereby, on one side, by the great volatility of the anhydrous acid, on the other side by the great fixity of the acid containing water, this kind of decomposition seems to be induced.

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* We shall be glad to have farther communication with E. A., and learn his address.—ED.

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* The specific gravities were determined by means of a small bottle, provided with a plate ground upon its neck.

Art. XIII.—*Observations on the Temperature of the Sea and the Air, and on the Specific Gravity of Sea Water, made during a Voyage from St Helena to England in* 1820. By John Davy, M. D. F. R. S. Communicated by the Author.

After quitting St Helena on the 6th May, I again resumed my observations on the temperature of the sea and the air.

May 6. S. Lat. 14° 59′, W. Long. 6° 22′. Out of sight of Land.

	Air.	Water.	Hygr.	Wind and Weather.		
8h A. M.	73°	74°	7°	S. by E.	gentle,	overcast.
10	74	74	7	SE.	do.	do.
12	75	74	9	SE.	do.	do.
3 P. M.	74.5	74.5	8	SE.	do.	do.
6	79	75	6	SE.	do.	do.

The night was moderate, and rather cloudy.

May 7. S. Lat. 13° 32′, W. Long. 8° 6′.

	Air.	Water.	Hygr.	Wind and Weather.		
8h A. M.	74°	75°.5	6°.5	SSE.	moderate,	overcast.
10	76	75.5	8.5	SE.	do.	clear.
12	77	76	7	SE.	do.	overcast.
3 P. M.	73	75.5	2.5	NE. by E.	moderate,	overcast, slight rain.
6	72	76.5	2	SE.	do.	slightly overcast.

The night was pretty fine, and the breeze moderate.

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[*] I quote these circumstances, that it may appear, how slowly the distillation proceeded. Probably no fuming acid will be formed, when the fluid in the retort is brought to boiling.

May 8. S. Lat. 12° 9′, W. Long. 10° 8′.

	Air.	Water.	Hygr.	Wind and Weather.		
8^{h} A. M.	74°	77°	4°	E. by N.	moderate,	slightly overcast.
10	77	77.5	7	Do.	do.	pretty clear.
12	77	77.5	6.5	SE. by E.	do.	overcast.

Since yesterday, at twelve o'clock, the ship has been carried by a current twenty-nine miles to the south. The sudden elevation of the temperature of the sea agrees with this.

	Air.	Water.	Hygr.	Wind and Weather.		
3^{h} P. M.	77°	78°	7°.5	SE. by S.	moderate,	overcast.
6	76	77.5	6	SSE.	gentle,	do.

The night was fine, and the breeze moderate.

May 9. S. Lat. 10° 50′, W. Long. 11° 37′.

	Air.	Water.	Hygr.	Wind and Weather.		
8^{h} A. M.	77°	78°	7°	SSE.	gentle,	clear.
10	78	77	7.5	SE.	moderate,	cloudy.
12	79	79	8	Do.	do.	do.
2 P. M.	78	79	7	Do.	do.	clear.
6	78	79.5	8	East,	do.	do.
9	77.5	—	5.5	Do.	do.	do.

During the twenty-four hours preceding noon, we have been carried twenty-seven miles to the west.

The night was fine, and the breeze moderate.

May 10. S. Lat. 8° 57′, W. Long. 13° 24′.

	Air.	Water.	Hygr.	Wind and Weather.		
8^{h} A. M.	78°	78°.5	5°	SE.	moderate,	cloudy.
10	78	79	5	Do.	do.	overcast.
12	79	79	6.5	Do.	do.	do.
3 P. M.	77.5	79.5	7.5	East,	do.	clear.
6	78	80	6	Do.	do.	do.
11	78.5	80	5	Do.	do.	do.

In the twenty-four hours preceding noon, the ship has been carried to the west fourteen miles.

At 5^{h} 30′ P. M. Ascension Island was seen in the horizon, immediately a-head. At first, we had some difficulty in distinguishing it, as it was about forty miles distant. The highest point of it is said to be 2400 feet above the level of the sea. At eleven o'clock at night, when I tried the temperature of the sea, we were about six miles from the island. About midnight, we were abreast of it, and we passed about three or four miles to the north-west of it. At day-light this morning, when the island was sixty miles behind us, it was distinctly visible. The island is rich only in turtle.

May 11. S. Lat. 6° 43′, W. Long. 14° 55′.

	Air.	Water.	Hygr.	Wind and Weather.		
8^h A. M.	80°.5	80°.5	6°.5	East,	moderate,	clear.
10	82	80.5	8	Do.	do.	do.
12	82	80.5	8	Do.	do.	do.
3 P. M.	81	80	7	Do.	do.	do.
6	79	80	5	E. by S.	do.	cloudy.

The wind was variable during the night, and there were several heavy showers.

May 12. S. Lat. 4° 54′, W. Long. 15° 53′.

	Air.	Water.	Hygr.	Wind and Weather.			
8^h A. M.	77°	80°	2°	East,	gentle,	overcast.	
10	78	80.5	2	SW.	do.	do.	
12	77.5	80.5	2	Do.	do.	do.	slight rains.
3 P. M.	79	80.5	7	S. by W.	do.	do.	pretty clear.
6	78	80	3	S. by E.	do.	do.	

At noon, we were in a very gentle current, setting to the north-west.

The night was fine, and the sea luminous.

May 13. S. Lat. 3° 5′, W. Long. 17° 1′.

	Air.	Water.	Hygr.	Wind and Weather.		
8^h A. M.	79°	80°	4°	S. by E.	gentle,	cloudy.
10	81	80.5	5	SSE.	moderate,	pretty clear.
12	82	80.5	6	Do.	do.	rather cloudy.
3 P. M.	81	80.5	5	ESE.	do.	do.
6	80	80	4	Do.	do.	do.

The night was fine, and the sea luminous.

During the twenty-four hours before noon, we were carried about ten miles to the south-west.

May 14. S. Lat. 1° 8′, W. Long. 18° 16′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	80°	79°.5	5°	E. by S. moderate, rather cloudy.
10	81	79.5	5	Do. do. do.
12	81	79.5	4	E. by N. do. do.
2 P. M.	80	80	4	East, do. pretty clear.
6	80	79.5	4	Do. do. do.
9	80	80	4	Do. do. clear.

The night was fresh, and we crossed the Line about 10h 28′ P. M.

We were carried, in twenty-four hours preceding noon, about sixteen miles to the west, and one or two to the south.

According to the observations collected by M. D'Apres, there are shoals near the Line, to the southward, between the meridians 21° W. and 18° W. A ship, for example, received a shock, as if from touching a sand-bank, in 0° 20′ S. Lat. and 20° 50′ W. Long.; another met with the same accident in 0° 20′ S. Lat. and 18° W. Long.; and a third in 1° 35′ S. Lat. and 17° 50′ W. Long. A sand island also was seen in 0° 23′, and 19° 10′ W. Long. The comparative low temperature of the sea to-day is in favour of the opinion that the bottom we have been passing over is not very deep, particularly so as the current seems to set rather southward than northward. Very many flying fish have been seen to-day; often more than 100 together.

May 15. N. Lat. 1° 24′, W. Long. 18° 40′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	81°	81°.5	4°.5	East, moderate, cloudy.
10	82	81.75	6	Do. do. do.
12	82.5	82	5.5	ESE. do. do.
3 P. M.	82	82.25	5	Do. do. do.
6	80	82	4	SE. do. do.

During the twenty-four hours preceding noon, we have been carried nine miles to the westward, and thirteen to the south.

A little after six in the evening, the weather changed. The wind became variable and squally, and the sky obscured with dark clouds, threatening rain. We shortened sail as speedily as possible; and whilst this was doing, the wind blowing hard and on our beam, the ship went with great rapidity, at the rate of twelve knots an hour. The effect of a vessel dashing through a sea of foam, brightly luminous, and emitting a silver light, was extremely beautiful and striking. The squall was soon accompanied with heavy rain, which lasted till about 10^h P. M. The rain then ceased, and the wind abated, and was moderate during the rest of the night.

May 16. N. Lat. D. R. 4° 13′, W. Long. 19° 15′.

	Air.	Water.	Hygr.	Wind and Weather.
7^h A. M.	82°.5	82°	6°	ESE. fresh, cloudy.
10	82	82	5.5	East, do. overcast.
12	77	81.5	2	Do. do. do. slight rain.
2 P. M.	79	81.5	3	ENE. moderate, overcast.
6	79	81	3.5	E. by N. do. do.

A squall, which threatened us at 10 A. M., commenced soon after, and lasted till noon. The wind was strong and variable. Our main-top-sheet was torn to pieces. The accompanying rain was heavy.

Between sunset and midnight, the weather was pleasant, the breeze gentle, and the wake of the ship was remarkably luminous. The luminous appearance was unusual, being confined to distinct oval luminous masses. Between midnight and sunrise, it was almost calm, and it rained the greater part of the time very heavily.

May 17. N. Lat. 6°, W. Long. 19° 17′.

	Air.	Water.	Hygr.	Wind and Weather.
7^h A. M.	79°	80°	2°	NE. gentle, overcast.
10	81.5	81	4.5	NE. by E. gentle, pretty clear.
12	82	81.5	5.5	NE. do. do.
2 P. M.	81	82	4	Do. very gentle, do.
6	80	81.5	4	Do. do. do.
9	81	—	6	Do. do. clear.

During the last forty-eight hours before noon, we have been carried about twenty-two miles to the north, and about as much to the north-east.

The night was very fine, and the breeze very gentle. Both now and formerly, I have observed the air warmer and drier at nine or ten o'clock than just after sunset.

We had the great pleasure, this day, of seeing once more the north pole star, a little above the horizon.

May 18. N. Lat. 6° 49′, E. Long. 20° 7′.

	Air.	Water.	Hygr.	Wind and Weather.		
8h A. M.	81°.5	80°.5	4°.5	NE. by N.	gentle,	clear.
10	82.5	80.5	6.5	Do.	do.	do.
12	82	81	5	NNE.	do.	cloudy.
3 P. M.	81	81.5	4.5	Do.	moderate,	pretty clear.
6	80	80.5	4	North	gentle,	do.
9	79	—	3	NNE.	do.	clear.

The night was fine. During the twenty-four hours before noon, we do not appear to have been in any current, yet, from the rippling of the surface last night, just before sunset, we were supposed to be in one; but this test seems to me a fallacious one.

May 19. N. Lat. 7° 27′, W. Long. 21° 46′.

	Air.	Water.	Hygr.	Wind and Weather.		
8h A. M.	77°	77°	2°.5	NNE.	moderate,	overcast.
10	78	77	5	Do.	do.	slightly do.
12	78.5	77.5	5	Do.	do.	pretty clear.
3 A. M.	78	78	5	NE. by N.	do.	slightly overc.
6	77	77	3	Do.	do.	do.
9	77	77	3	Do.	do.	pretty clear.

The night was fine. During the twenty-four hours preceding noon, we have been carried sixteen miles south, and six west. The remarkable change in the temperature of the water indicated a southerly current. From the temperature of the water at six o'clock last night, I infer that we were not then in the current. Hence we may conclude, that its course is not rapid. May not this current be connected with the Gulf Stream reflected from the African coast?

May 20. N. Lat. 8° 10′, W. Long. 23° 17′.

	Air.	Water.	Hygr.	Wind and Weather.		
7h A. M.	78°	77°	3°	NE. by N.	moderate,	pretty clear.
10	79	78	4	Do.	do.	do.
12	79	78.5	4	Do.	do.	do.
3 P. M.	78	78	3	Do.	do.	slightly overcast.
6	77	78	3	N. by E.	do.	pretty clear.

The night was fine. During the twenty-four hours preceding noon, we have been carried eight miles south, but no way to the west.

May 21. N. Lat. 9° 1′, W. Long. 25° 8′.

	Air.	Water.	Hygr.	Wind and Weather.		
8^h A. M.	76°	77°.5	4°	N. by E.	moderate,	overcast.
10	77	77	5	Do.	do.	slightly do.
12	77	77	5	NNE.	do.	do.
3 P. M.	76	76.5	4.5	Do.	do.	pretty clear.
6	75	76.5	3.5	NE.	do.	do.
9	75	—	3.5	NE. by N.	do.	do.

The night was fine. In the twenty-four hours before noon, we have been carried by the current eight miles to the south.

May 22. N. Lat. 10° 25′, West Long. 26° 53′.

	Air.	Water.	Hygr.	Wind and Weather.		
8^h A. M.	75°.5	75°.5	4°.5	NE. by N.	moderate,	slightly overc.
10	76	76	5	Do.	do.	do.
12	77	76.5	5.5	Do.	do.	do.
3 P. M.	76	76.5	5	Do.	fresh,	do.
6	75	75	4.5	Do.	do.	rather cloudy.

The night was tolerably fine. In the twenty-four hours before noon, we have been carried five miles to the northward, and in the forty-eight hours, fifteen miles to the westward.

May 23. N. Lat. 12° 6′, W. Long. 28° 28′.

	Air.	Water.	Hygr.	Wind and Weather.		
7^h A. M.	75°	76°	6°	NNE.	moderate,	pretty clear.
10	77	76.5	7	Do.	do.	do.
12	77	77	7	Do.	fresh,	cloudy.
3 P. M.	75.5	77	5.5	Do.	do.	rather cloudy.
6	74.5	76	5.5	Do.	do.	do.

The night was cloudy, and the wind fresh. In the twenty-four hours before noon, we have been carried fourteen miles to the WSW.

May 24. N. Lat. 13° 52′, W. Long. 30° 32′.

	Air.	Water.	Hygr.	Wind and Weather.		
8^h A. M.	73°.5	74°.5	4°.5	NNE.	fresh,	cloudy.
10	75	74	5	Do.	do.	do.
12	75	73.5	6.5	Do.	do.	pretty clear.
3 P. M.	74	73.5	5	Do.	do.	overcast.
6	73	73.4	4	Do.	do.	do.

The night was similar to the preceding. In the twenty-four hours before noon, we have been carried twenty miles to the west.

May 25. N. Lat. 15° 50′, W. Long. 32° 38′.

	Air.	Water.	Hygr.	Wind and Weather.
8^h A. M.	73°	73°	4°	NE. strong, overcast.
10	74.5	73	5	Do. do. do.
12	75	73	5.5	Do. do. cloudy.
3 P. M.	74	73	5	Do. do. do.
6	73	73	4	NE. by E. do. do.

The night was like the preceding. In the twenty-four hours before noon, we have been carried about eighteen miles to the west, and about four to the south.

May 26. N. Lat. 18° 15′, W. Long. 34° 6′.

	Air.	Water.	Hygr.	Wind and Weather.
8^h A. M.	72°.5	73°.5	4°	NE. by E. strong, overcast.
10	73.5	73.5	5	Do. do. do.
12	73 5	74	5	Do. do. do.
3 P. M.	73,5	79	5	Do. fresh, clear.
6	73	73.5	5	Do. do. rather cloudy.

The night was tolerably fine, and the wind fresh. The current still sets to the westward, but not to the southward. The weather is boisterous and squally, and the sea running high. During the two first nights, the highest clouds have been moving in a direction opposite to that of the lower, which have followed the course of the wind. The latter had travelled rapidly, the former slowly.

May 27. N. Lat. 20° 55′, W. Long. 35° 49′.

	Air.	Water.	Hygr.	Wind and Weather.
8^h A. M.	72°.5	73°	5°.5	NE. fresh, overcast.
10	73	73	5	Do. do. do.
12	73.5	73.5	4.5	NE. by E. do. do.
3 P. M.	73	73.5	6	Do. do. clear.
6	72.5	73.5	6	E. by N. do. cloudy.
9	72.5	—	5	Do. moderate, clear.

During the twenty-four hours before noon, we have been carried about eighteen miles to the west, and about seven to the north. A good many pieces of sea-weed were seen floating this evening, resembling in colour and figure the common spray. They generally make their appearance, and in great quantities, a little farther to the north. They are supposed to be brought from the American coast by the current, which may be considered a branch of the Gulf Stream. Not only these weeds, but the state of the thermometer, seem to indicate that we have been in a current to-day. The night was very fine, and the breeze moderate. We saw the southern coast a little above the horizon.

May 28. N. Lat. 23° 27′, W. Long. 37° 8′.

	Air.	Water.	Hygr.	Wind and Weather.		
8^h A. M.	74°	73°	7°.5	E. by N.	moderate, clear.	
10	73.5	74	5.5	NE.	do.	rather cloudy.
12	74.5	74	7.5	Do.	do.	clear.
3 P. M.	73	74	5.5	E. by N.	do.	do.
6	72	79	5	Do.	do.	rather cloudy.

The night was fine, and the weather delightful. In the twenty-four hours before noon, we have been carried fourteen miles to the west, and twenty to the northward.

May 29. N. Lat. 25° 50′, W. Long. 37° 50′.

	Air.	Water.	Hygr.	Wind and Weather.		
8^h A. M.	72°.5	72°.5	8°	E. by N.	moderate, pretty clear.	
10	74	73	7	Do.	do.	do.
12	73.5	73	7	Do.	do.	do.
3 P. M.	72	73	5	Do.	do.	do.
6	71	72	7	Do.	do. a squall approaching.	

During the twenty-four hours before noon, we have been carried thirty-two miles to the west, and ten to the northward. A little sea-weed was seen yesterday, and a good deal this morning. It is a delicate species of fucus. The stem and branches were cylindrical, and the leaves long and lanceolated, and there were attached to the branches numerous hollow spherical bodies. The colour of the weed was between light apple-green and straw-yellow. Many of the spherical bodies were enveloped in a delicate crust, or a reticulated coralloid, quite white. Several small eels, of the same species, were caught on the weed, and two or three gelatinous bodies, of regular forms, and irritable.

The squall, which occurred at six P. M., was short, and attended by slight showers.

May 30. N. Lat. 28° 1′, W. Long. 37° 57′.

	Air.	Water.	Hygr.	Wind and Weather.		
8h A. M.	72°	72°	7°	East,	moderate,	pretty clear,
10	73	72	7	Do	do.	light clouds.
12	72.5	72	6·5	Do.	do.	cloudy.
3 P. M.	72	72.5	6	Do.	do.	pretty clear,
6	71	71	5	E. by S.	do.	do.
9	70	—	4	Do.	do.	do. after a shower.

The night was moderate. In the twenty-four hours, we have been carried by the current twenty-five miles to the west. Sea-weed, in great quantities, similar to that noticed before, has been seen to-day.

May 31. N. Lat. 29° 48′, W. Long. 37° 31.′

	Air.	Water.	Hygr.	Wind and Weather.		
8h A. M.	72°	70°.5	5°	E. by S.	moderate,	light clouds.
10	70	70.5	6	Do.	very gentle,	overcast, slight rain.
12	67	70	2.5	N.	gentle,	overcast.
3 P. M.	70	70.5	6	NE.	very gentle,	rather cloudy.
6	69	69.5	4.5	Do.	do.	light clouds.
8	68.5	—	3.5	Do.	gentle,	pretty clear.

The night was fine, and the breeze gentle. The north-east trade-wind frequently ceases, and variable winds succeed it. Very little sea-weed has been seen to-day.

June 1. N. Lat. 31° 8′, W. Long. 38° 27.

	Air.	Water.	Hygr.	Wind and Weather.		
8h A. M.	69°	69°	4°	E. by N.	very gentle,	light clouds.
10	70.5	70	5	East,	gentle,	do.
12	70	70	4	E. by N.	do.	clear.
3 P. M.	70	70	5	ESE.	do.	do.
6	69	69.5	4.5	E. by N.	do.	do.
9	68.5	—	4.5	Do.	do.	do.

The night was fine, the wind very gentle, and the sea unusually smooth.

In the last twenty-four hours we appear to have been carried a little way by a current to the north-west.

June 2. N. Lat. 32° 25′, W. Long. 38° 35.

	Air.	Water.	Hygr.	Wind and Weather.		
8h A. M.	71°	70°	6°	NE. by E.	very gentle,	clear.
10	71	71	7	NE.	do.	do.
12	71	71	7	Do.	do.	do.
3 P. M.	71	71.5	7	Do.	calm.	do.
6	70	72	7	Do.	do.	do.
9	68.5	70.5	5.5	Do.	do.	do.

The night was fine and calm. The current, during the twenty-four hours, has carried us a little way to the south-westward. It was found by an experiment of the first mate, Mr Harrison, to be flowing north-west about half a mile an hour.

June 3. N. Lat. 33° 12′, W. Long. 38° 34′.

	Air.	Water.	Hygr.	Wind and Weather.		
7h A. M.	71°	69°	6°	NE. by E.	very gentle,	clear.
10	71	69.5	6	East,	gentle,	light clouds.
12	71	70.5	6	Do.	do.	clear.
3 P. M.	70.5	71.5	5.5	ESE.	very gentle,	do.
6	70	71	5	Do.	do.	light clouds.
9	70	70.5	5	Do.	do.	do.

The night was fine, and the breeze very gentle. A great many species of aquatic animals were seen, the appearance of many of which was beautiful, resembling, in colour and form, flowers rather than animals.

June 4. N. Lat. 34° 8′, W. Long. 37° 57′.

	Air.	Water.	Hygr.	Wind and Weather.		
8h A. M.	70°.5	70°.5	5°	ESE.	very gentle,	clear.
10	72	71	6.5	Do.	do.	do.
12	73.5	72	7	Do.	do.	do.
3 P. M.	72	72	6	SE. by S.	gentle,	do.
6	71	71.5	5.5	S. by W.	do.	rather cloudy.
9	70	—	5	Do.	do.	overcast.

The night was moderate, and the breeze gentle. Some sea-weed, similar to the former, was seen to-day, as well as the day before. The current has set gently to the north-westward. In the last twenty-four hours, we have been carried by it five miles to the westward, and six to the northward.

June 5. N. Lat. 35° 3′, W. Long. 36° 25′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	70°.5	69°.5	3°.5	S. by W. gentle, slightly overcast.
10	71.5	68.5	5	SW. do. do.
12	71.5	68	5	WSW. do. do.
3 P. M.	70.5	69	3.5	Do. moderate, do.
6	70	68.5	2.5	Do. do. do.
9	69.5	—	2	Do. do. do.

The night was rather squally, and towards the morning there was heavy rain.

June 6. N. Lat. 36° 53′, W. Long. 33° 53′.

	Air.	Water.	Hygr.	Wind and Weather.
8 A. M.	68°	66°.5	2°	S. strong, overcast.
2 P. M.	67	66.5	2	W. squally, do.
5	66	66	1	SW. do. do. slight rain.

It was stormy the whole of the morning, and the rain was incessant, and very heavy. The night was also stormy, and the showers frequent and heavy.

June 7. N. Lat. 39° 46′, W. Long. 33° 16′.

	Air.	Water.	Hygr.	Wind and Weather.
9h A. M.	65°.5	64°.5	2°	S. squally, overcast.
12	65	64	2.5	S. by E. do. do.
3 A. M.	65.5	64	2.5	Do. do. do.
7	66	65	3	SSE. strong, pretty clear.

The night was pretty clear, and the gale abating. The sea ran high. We have seen none of the Azores, the most northern of which we have now nearly cleared.

June 8. N. Lat. 42° 16′, W. Long. 30° 36′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	65°	64°	5°	SE. fresh, pretty clear.
12	65	64	5	Do. do. do.
3 P. M.	65	64.5	5	Do. do. do.
6	64	64.5	4	Do. do. cloudy.
8	64	64.5	4	Do. do. do.

The night was fine, and the wind moderate.

June 9. N. Lat. 43° 58′, W. Long. 28° 13′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	63°	62°.5	4°.5	SE. by S. moderate, cloudy.
10	64	63	5	Do. do. do.
12	64.5	63.5	5	SE. do. do.
3 P. M.	62.5	63.5	3.5	Do. gentle, rather cloudy.
6	63	63.5	3.5	SSE. do. pretty clear.
9	63.5	—	4	S. by E. do. do.

During the last three days, we have been in a current setting to the north-eastward. In the last twenty-four hours, we have been carried about twenty-eight miles to the northward, and as many to the eastward.

June 10. N. Lat. 44° 51′, W. Long. 26° 37′.

	Air.	Water.	Hygr.	Wind and Weather.
7h A. M.	63°	62°.5	3°	S. by E. gentle, pretty clear.
10	64	63	4	SSE. do. slightly overcast.
12	65	63.5	4.5	Do. do. pretty clear.
3 P. M.	64.5	64	4	S. by E. do. slightly overcast.
6	64	64	4	SW. do. pretty clear.
9	64	—	3.5	Do. do. do.

The night was fine, and the breeze gentle. In the last twenty-four hours the current has set strongly to the northward, and slightly to the eastward.

The sea, during the last three days, has looked greenish.

June 11. N. Lat. 45° 12′, W. Long. 24° 21′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	63°	64°.5	4°	S. by W. gentle, rather cloudy.
10	64	63.5	4	SW. by W. do. do.
12	66	63.5	6	WSW. do. do.
3 P. M.	65	64.5	5	W. by N. do. do.
6	64.5	63.5	4	NW. do. do.
8	64	63.5	4	Do. do. do.

The night was moderate, and cloudy. During the last twenty-four hours, the current has set strongly to the eastward.

June 12. N. Lat. 46° 4′, W. Long. 21° 44′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	63°	61°.5	2°	NNE. moderate, cloudy.
10	62	61.5	1	N. very gentle, overcast, after slight rain.
12	63	62	2	Do. do. do.
3 P. M.	62.5	61.5	2	NE. do. do.
6	62	61.5	3	NE. by N. fresh, do.

There was very little wind during the night. The current appeared during the last twenty-four hours.

June 13. N. Lat. 46° 8′, W. Long. 19° 51′.

	Air.	Water.	Hygr.	Wind and Weather.			
8h A. M.	61°	61°	5°	NNE. very gentle, overcast.			
10	61.5	61.5	2	Do.	do.	do.	slight rain.
12	62	62.5	3	NE.	do.	clear.	
3 P. M.	61.5	63	4.5	Do.	do.	do.	
6	61	61.5	4.5	Do.	do.	do.	
8	59.5	61.5	4.5	Do.	do.	do.	

The night was fine, and almost calm. During the last twenty-four hours, we have been in a current setting to the eastward.

June 14. N. Lat. 46° 11′, W. Long. 18° 21′.

	Air.	Water.	Hygr.	Wind and Weather.		
8h A. M.	59°	60°	3°	E. by N. very gentle, clear.		
10	58.5	60	4	Do.	gentle,	do.
12	59	61	4	Do.	do.	do.
3 P. M.	59	61	4	Do.	do.	do.
6	58.5	61	4	Do.	do.	do.
8	57	60.5	4	Do.	do.	do.

The night was fine, and nearly calm. The current set today to the north-east, but not strongly.

June 15. N. Lat. 45° 49′, W. Long. 17° 25′.

	Air.	Water.	Hygr.	Wind and Weather.		
8h A. M.	57°	60°	4°	E. by N. very gentle, clear.		
10	57.5	60.5	4	Do.	do.	do.
12	58	62	4	Calm,	—	do.
3 P. M.	60	63	6	Do.	—	do.
6	60	61.5	5	Do.	—	do.
8	59	61	5	Do.	—	do.
10	58	60	4.5	Do.	—	do.

The current, during the last twenty-four hours, has set gently to the south-eastward.

Though the air is so cool, yet the sun is powerful. Not a single cloud, or any vapour, is to be seen in the sky; and the calmness is such, that the sea is like a mill-pool, and reflects the images of the moon and of Venus. The calm continued through the night, till sunrise, when a gentle breeze sprung up from the north-west.

June 16. N. Lat. 45° 57′, W. Long. 17°.

	Air.	Water.	Hygr.	Wind and Weather.
5h A. M.	58°.5	59°	2°	NW. very gentle, clear.
8	60	60	3	NW. by W. do. do.
10	61.5	60.5	3.5	Do. do. do.
12	62	61.5	3.5	Do. do. do.
3 P. M.	63	60.5	3.5	Do. gentle, do.
6	64	60.5	4.5	Do. do. do.
8	62	60.5	2	Do. do. do.

The night was fine, and the wind gentle. During the last twenty-four hours, there was no appearance of a current.

Though it was completely calm during the night, and the air very clear, yet there were no indications of dew. The circumstances ascertained by the thermometer and hygrometer were certainly sufficient to prevent it; and there is reason to believe that they afford a good general explanation of dew never making its appearance at sea at a great distance from land. The observations on the temperature of the sea, and on the temperature and dryness of the air, are interesting in other respects, especially as indicating the effects of the sun's rays on the air and sea by day, and the effect of the radiation, and of heat, from the sea to the air, by night.

June 17. N. Lat. 47° 5′, W. Long. 14° 12′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	60°.5	59°	1°.5	NNW. gentle, pretty clear.
10	61	59.5	1.5	Do. do. slightly overcast.
12	62	59.5	2	N. by W. do. do.
3 P. M.	62	59	2	Do. do. do.
6	61	59	2	Do. do. do.
8	60	58.5	1.5	W. by S. do. do.

The night was moderate. During the twenty-four hours a current has set to the eastward.

June 18. N. Lat. 47° 59′, W. Long. 12° 8′.

	Air.	Water.	Hygr.	Wind and Weather.
8h A. M.	61°	58°	1°.5	W. moderate, hazy.
10	61.5	58.5	2	Do. do. slightly overcast.
12	62	58.5	2.5	Do. do. pretty clear.
3 P. M.	61.5	58.5	2	Do. fresh, overcast.
5	61	57	—	Do. do. do.
8	—	56	—	Do. do. do. raining.

The night was tolerably fine, and the wind fresh.

June 19. N. Lat. W. Long.

	Air.	Water.	Hygr.	Wind and Weather.
6h A. M.	56°	56°	3°	N. fresh, clear.
8	56	55.5	4	N. by E. do. do.
10	55.5	55.5	4	N. by E. do. do.
12	56	55.5	5	N. by W. do. do.
3 P. M.	56	55.5	4	Do. do. do.
7	55	54.5	4	N. by E. do. overcast.

During the two last days the current has set very little to the eastward. Captain Stewart was of opinion that we were in soundings, and that we entered them last night about the time when the temperature of the water suddenly fell about two degrees.

About nine o'clock we saw the Lizard Light.

June 20.

	Air.	Water.	Hygr.	Wind and Weather.
3⅓h A. M.	53°	53°	3°	NW. by N. fresh, pretty clear, Off the Lizard.
7	54	54	3.5	Do. do. do. Off the Eddystone.
10	54.5	52.5	4	Do. do. cloudy, Off the Bolthead.
12	56	5.35	4	W. fresh, cloudy, Off Froward Point.
3 A. M.	56	53.5	4	W. moderate, do.
6	55	54	—	W. by N. gentle, pretty clear, Off Portland.

June 21.

	Air.	Water.	Wind and Weather.
5h A. M.	52°	55°	N. by E. gentle, clear, Off the Isle of Wight.
3 P. M.	60	55	W. gentle, pretty clear, Off Arundel.
7	57	56	W. very gentle, clear, Off Beachyhead about 3 miles.

June 22.

	Air.	Water.	Wind and Weather.
4h A. M.	55°	56°	W. very gentle, clear, Dungeness a-head, & in sight.
12	59	55.5	W. gentle, do. Off Dover about ½ mile.
6 P. M.	60	56-5	SW. gentle, cloudy, Passing through the Downs.

June 24. Since the 22d, we have been coming up the river with the tide, the wind being either very light or contrary. About noon to-day we reached Gravesend, and landed.

London, July 16. I have just ascertained the specific gravities of the different specimens of sea-water which I took up between the Cape and England. There appeared to be no sensible loss by evaporation. Each bottle was quite sweet and unaltered. I used the delicate balance of the Royal Institution, and a bottle with a long neck, weighing 778 grains, and of the temperature of 63°, holding 970.3 grains of distilled water. On the sides of the glass stople there was a fine groove. The temperature of the different specimens of sea-water was the same as that of distilled water, viz. 63°. Most of the experiments were twice repeated.

No.	Lat.	Long.	Specific Gravity.
1	30° 6′ S.	11° 42′ E.	102667
2	26 55	7 34	102671
3	6 0 N.	19 17 W.	102667
4	9 5	25 8	102671
5	12 6	28 28	102671
6	15 56	32 38	102762
7	18 15	34 6	102762
8	20 55	35 49	102762
9	23 27	37 8	102823
10	28 1	37 57	102823
11	31 8	38 27	102762
12	34 8	37 57	102823
13	42 10	30 36	102742
14	44 51	26 37	102721
15	47 5	14 12	102721
16	49 3	8 1	102721
17	Off Dover ½ mile.	—	102648

ART. XIV.—*Description of Gmelinite, a New Mineral Species.* By DAVID BREWSTER, LL. D. F. R. S. Lond. and Sec. R. S. Edin.

AMONG the minerals of Monte Somma, the late Mr Thomson of Cambridge discovered some crystals of a flesh-red colour, to which he gave the name of *Sarcolite*. The Abbé Hauy, to whom he sent some fragments of these crystals, found them to be cubes, having their solid angles replaced by eight faces, each of which was inclined about 125° to the faces of the cube. As these crystals had a vitreous aspect, and scratched glass, Hauy did not scruple to consider them as a variety of Analcime.* In this opinion, he has been followed by all succeeding writers on mineralogy, and when cubical crystals of a flesh-red colour were discovered in Arthur Seat, the same trivial name of *sarcolite* was used to designate that acknowledged variety of Analcime.

At Montecchio-Maggiore, and at Castel, in the Vicentine, there was afterwards discovered another substance which Hauy and other mineralogists have regarded as sarcolite. It was of a flesh-red colour, and occurred in small rounded masses engaged in wacke. It accompanied white crystals of Analcime, and though it had a less vitreous fracture than the sarcolite of Thomson, yet, by Hauy's observations, it was found to pass into the Analcime, assuming by degrees the vitreous tissue of the latter.

According to the analysis of Vauquelin, however, the flesh-coloured crystals of the Vicentine contained less soda, and more water, than Analcime, and although M. Leman had disengaged from a mass of sarcolite from Castel some crystals of the form of hexaedral prisms, terminated by hexaedral pyramids, which Vauquelin considered to be the same as the amorphous variety, yet Hauy and all succeeding writers on mineralogy have still regarded these substances as Analcime.† That the six-sided prisms of Leman could not possibly be united to Analcime ought to have been very obvious; but their similarity in form, composition, hardness, and specific gravity to Chabasie rendered it probable that they belonged to that species.

Mr Allan, whose cabinet has enriched mineralogy with so many new species, had the good fortune to pick up in the Little Deer Park of Glenarm, in the county of Antrim, a specimen, containing two or three fine crystals of a whitish aspect, resembling the six-sided prisms of Leman, and which

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[*] *Traité*, 2d Edit. Tom. III. p. 177, 179.

[†] De Drée, in his *Catalogue des Huit Collections*, p. 18, designates the substance analysed by Vauquelin by the name of Hydrolite, a name given by Sir George Mackenzie to the Stalactitical Opal produced by hot springs.

he considered as the same substance.* As I had devoted much attention to the examination of the Analcime and the Chabasie, Mr Haidinger was so good as to put into my hands this interesting specimen, and also a specimen of the flesh-coloured masses from the Vicentine. The slightest comparison of these substances in their optical characters, put it beyond a doubt, that they had no relation to Analcime or Chabasie, and that the whitish crystals from Glenarm were similar to the flesh-coloured masses from the Vicentine, and formed a new and a very interesting mineral species.

To this species I propose to give the name of *Gmelinite*, in compliment to G. C. GMELIN, Professor of Chemistry in the University of Tübingen, whose analyses of minerals have ranked him among the first analytical chemists of the present day, and whose friendship I am happy to have the present opportunity of acknowledging.

This new species comprehends the flat six-sided prisms from Glenarm, and the flesh-coloured masses which accompany them; the flesh-coloured mineral from the Vicentine, and probably the six-sided prisms observed by Leman.

The Gmelinite from Glenarm crystallises in the form shown in Plate VIII. Fig. 2, which is a regular hexagonal prism, terminated at both ends by six-sided pyramids, with flat summits. The following are the angles of the crystal, taken with the reflective goniometer. See Plate VIII. Fig. 2.

u upon *y*	131°	48
o —— *y*	138	14
u —— *u*	120°	0
y —— *y′*	96°	24

Rhombohedral. Combination P — ∞. P. P + ∞. The angles of the isosceles pyramid = 145° 54′, 71° 48′.

Cleavage distinct, parallel to R. Fracture uneven. Surface streaked, the prism in a horizontal direction, the isosceles pyramid parallel to the edges of combination with R; R — ∞ rough, but even.†

The flesh-coloured Gmelinite, from the Vicentine, has more than one cleavage. It is very imperfectly crystallized;

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* *Mineralogical Nomenclature*, Edit. 1819, Voc. ANALCIME.

† For this character of the combination and cleavage, as well as the figure, I have been indebted to Mr Haidinger.

but transmits light when reduced to a considerable degree of thinness. It often contains small spherical groupes of filamentous crystals, intensely white, which, if they are Gmelinite, which is not probable, must have lost their water of crystallization.

The specific gravity of the flesh-coloured Gmelinite, from the Vicentine, is 2.05, and its hardness about 4.5, scratching glass with some difficulty. The crystallized variety from Glenarm appears to have a less degree of hardness.

The optical structure of the Gmelinite differs entirely from that of the Analcime, or the Chabasie, both of which are composite minerals, the individuals of which they are composed having never yet been found in nature. The double refraction of Gmelinite exceeds that of Analcime and Chabasie, and may be distinctly seen through the two opposite faces of the pyramid by immersing it in water, which gives a great degree of transparency to the Glenarm crystals. The double refraction is negative in relation to the axis of prism, which is the axis of double refraction.

The flesh-coloured masses from the Vicentine are also simple substances, which, though rendered imperfectly transparent by flaws and disseminated matter, give distinctly the colours of polarised light. Their index of ordinary refraction is about 1.474, less than that of almond oil. By immersing the summit of one of the Glenarm crystals in a parallelopiped of almond oil, I was enabled, without detaching the crystal from its matrix, to ascertain that its refractive power was also inferior to that of almond oil, and in the same degree as the flesh-coloured masses. As the refractive power, both of Analcime and Chabasie exceed considerably that of almond oil, this simple experiment, which requires no other skill than that of looking through the crystal, establishes the identity of the minerals from Glenarm and the Vicentine, and fixes them as a new mineral species different from Analcime and Chabasie.

The chemical characters of Gmelinite are not less distinctive and interesting than its optical ones. When we hold a fragment of the Vicentine crystals near the flame of the candle, and supported in a loop of platinum wire, small portions gradually raise themselves, and after standing on their ends as if they were under the influence of electricity, they are propelled with violence from the fragment. The continued application of the heat drives off the water of crystallization, and reduces the fragment to a white fibrous-looking powder. In performing this experiment, by exposing the fragment on a piece of glass to the fire, I was surprised to observe, upon looking at the powder with a microscope, that many of the particles were in a state of restlessness, some of them leaping from the glass, and others endeavouring to separate themselves from the larger particles to which they were attached. This effect was no doubt owing to the heat of the glass, which continued to expel the water of crystallization which still remained in some of the particles, for I could not discover in the powder any trace of pyro-electricity. The property which has now been described is possessed also by the Gmelinite from Glenarm, but it is not possessed by Analcime or Chabasie, or, so far as I know, by any other mineral, and may be regarded as an infallible chemical character of this species.

The following is the composition of the Gmelinites from the Vicentine, according to Vauquelin.

	Gmelinite from Montecchio Maggiore.	Gmelinite from Castel.
Silex	50	50
Alumine	20	20
Lime	4.5	4.25
Soda	4.5	4.25
Water	21	20
Loss	0	1.5
	100	100

I cannot conclude this notice without directing the attention of the philosophical mineralogist to the peculiar value of optical characters. The analysis of the Vicentine minerals by Vauquelin gave results so like those obtained from the Chabasies, that the chemical mineralogists even never felt themselves authorized to consider them as new. In hardness and specific gravity these minerals were almost exactly the same as Chabasie, and the obtuse rhomboid from which the six-sided prisms from Castel are derivable, has almost the same angle as that of Chabasie. Hence, Mr Haidinger was led to consider them as Chabasies, and, indeed, in any system which does not take cognizance of chemical and optical characters, they must be ranked with that species. From this perplexity the optical method immediately relieves us, not merely by detecting unequivocal characters in the mineral under examination, but by insulating, as it were, the kindred species of Analcime and Chabasie, which possess a composite structure of the most remarkable kind.

ART. XV.—*Description of a New Quicksilver Pump.*[*] Invented by MR THOMAS CLARK, Edinburgh. Communicated by the Inventor.

THE new machine invented by Mr Thomas Clark, for raising water, is a quicksilver pump, and works without friction. It has great power in drawing and forcing water to any height, and is extremely simple in its construction. It is made by twisting a piece of iron tube into the form of a ring, ABC, Plate IV. Fig. 4, having the ends of the tube bent into the centre D, and again bent outwards so as to form an axle to the wheel or ring thus formed. One of the ends of the axle is inserted, by means of a stuffing box at D, into the side of the main pipe EF, which leads down to the well, which allows it to move easily, and at the same time keeps it air tight. In the main pipe EF, immediately below where the axle is inserted, or at any other convenient distance, is placed a valve *g* lifting upwards, another valve *h* lifting upwards is also placed immediately above the axle, or at any other convenient distance. There is now put into the iron ring a quantity of quicksilver, filling it from *k* to *l*, which slides backwards and forwards as the ring is made to vibrate upon its axis in the stuffing box at D, forming a vacuum in the main pipe as the silver recedes in the tube from A to C; the water rushes up from F to fill the vacuum, and when the silver slides back again towards A, the water is expelled through the upper valve *h*, and escapes at the top of the main pipe at *i*. A wheel of twelve or thirteen feet diameter will lift water the same height as a common lifting pump, and force it 150 feet higher, without any friction.

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[*] Our readers will observe, that this very ingenious quicksilver pump is essentially different from that of Mr Haskins, which is described in the EDINBURGH ENCYCLOPÆDIA, Art. PUMP, Vol. XVII. p. 307.

ART. XVI.—*Analysis of Helvine*. By C. G. GMELIN, Professor of Chemistry in the University of Tübingen. Communicated by the Author.

THIS very rare mineral occurred formerly in a peculiar bed-formation, (Lager-f.) on primitive mountains, accompanied by brown blende, fluor spar, quartz, schiefer spar, chlorite, &c. in the neighbourhood of Schwarzenberg, in the Saxon Erzgebirge. The first notice and previous characteristic of it was communicated by Professor Mohs,* who placed it in an appendix close to common garnet, as a mineral not yet determined. Werner made a peculiar species of it, which he placed in his system between colophonite and garnet, and named it, on account of its marked yellow colour, *Helvin*, after the Greek ἥλιος, the *sun*. Professor Mohs, in his *Grundriss der Mineralogie*, joined the Helvine to the genus garnet, by the name of tetrahedral Garnet. Mr Breithaupt placed it in his sphen-kiesel genus, and Mr Cordier thought that it might be united with Crichtonite, a sparry magnetic iron-ore, containing oxide of titanium.

We possess already a chemical analysis of Helvine by Dr Vogel of Munich,† according to which it is composed of—

Silica - - -	39.80
Alumine - - -	18.65
Lime - - -	0.50
Oxide of iron - - -	37.75
Oxide of manganese -	3.75
	97.15

The action of the blow-pipe upon Helvine clearly shows, as has already been observed by Professor Berzelius, ‡ that manganese is a principal ingredient in this mineral, and that iron can only be contained in it in a small quantity. The method of separating iron from manganese, followed by Dr Vogel, who was provided only with a small quantity of this mineral, does not seem to be sufficiently exact. I agreed, therefore, with pleasure to the wish of my friend Mr Breithaupt, who kindly provided me with a considerable quantity of this rare mineral, to subject it to a repeated analysis.

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* Beschreib. des von der Null schen Minerallien Kabinets, Abth. p. 92.

† Schweigger's *Journal*, Vol. XXIX. p. 319.

‡ Use of the blow-pipe, &c.

Specific gravity of Helvine.—This was found by a very sensible balance to be 3.166, the temperature of the water being +6° R. According to Mr Breithaupt, it is between 3.1 and 3.3.

Relations before the blow-pipe.—As to these I refer to the inquiry of Professor Berzelius,[*] with whom I agreed in the results. The sparkling which ensues, according to Dr Vogel, when Helvine is held in the flame, I have likewise distinctly observed. But I endeavoured, in vain, to discover the sulphur contained in it, by means of the blow-pipe. It appears that the large quantity of oxide of manganese, which, together with sulphate of manganese, forms an ingredient in Helvine, destroys the reactions for sulphur. The slowness, on the other hand, with which the manganese-reaction, by means of soda upon a platinum lamina ensues, might be derived from the sulphur contained in it.

Analysis.—(1.) Relying upon the assertion,[†] that acids do not act upon Helvine, and considering that, in the analysis of Dr Vogel, sulphur is not mentioned to be an ingredient, I resolved to decompose the mineral previously reduced to an impalpable powder by trituration with water,[‡] by means of carbonate of barytes, in order to discover any alkaline substance that might be contained in it. 3.712 grammes of the powder were mixed with six times their weight of carbonate of barytes, and ignited in a platinum crucible. There was obtained a blackish-blue mass hardly cohering, which, in some spots, appeared in a melted state, muriatic acid being poured upon this mass, previously soaked by water, such a quantity of sulphuretted hydrogen was disengaged, that the vessel, containing the solution, required to be removed out of the room;

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[*] Use of the blow-pipe, &c.

[†] Leonhard's *Handb. der Oryktognosie*, p. 431.

[‡] It deserves to be noticed, that water, with which Helvine is triturated, passes quite clear through the filtre, which, in general, never happens with other minerals similarly treated.

at the same time, some lac sulphuris was precipitated, and, as it seemed, sulphate of barytes, together with silica, not dissolved by the acid. The solution was now evaporated to perfect dryness in a water-bath, the residue treated with water and a little muriatic acid, the substance left undissolved washed upon a filtre with boiling water and ignited, then boiled with a solution of carbonate of potash, obtained by ignition of the crystallized carbonate, and the solution filtered boiling. There remained upon the filtre a white loose powder; and in the liquid, which had passed quite clear through the filtre, a great quantity of a gelatinous semitransparent precipitate of silica was formed, which was entirely dissolved again by heating the liquor, and appeared anew by cooling.* The powder that remained upon the filtre was carbonate of barytes, with traces of undecomposed sulphate of barytes. The liquor separated from sulphate of barytes and silica by the filtre was thrown down by carbonate of ammonia, filtered, evaporated, and ignited. There was left a substance not soluble in water, which, because the absence of an alkaline substance had been proved, was not particularly examined.†

(2.) The method of analysis followed in No. 1. not having led to a satisfactory result, I inquired particularly whether Helvine might not be decomposed by acids; and then found, that it is, in fact, decomposed by muriatic acid at a moderate digestion heat, with the disengagement of sulphuretted hydrogen, and that it even forms a jelly with that acid.

a. 1.927 grammes of the dried powder of Helvine were poured over in a porcelain dish with fuming nitric acid, free from sulphuric acid, and then a certain quantity of fuming muriatic acid was added. By digestion a jelly was formed, the liquor heated to boiling, and evaporated at last at a moderate heat to full dryness. Silica was separated perfectly white; it weighed after ignition 0.64088 gr. = 33.258 per cent.

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* Professor C. H. Pfaff was the first, so far as I know, who observed, that silica is perfectly and in abundance dissolved by the pure subcarbonates of potash and soda, when heated with the solutions of these salts. (*Journ.* of Schweigger, Vol. XXIX. p. 383.)

† It appears from the following inquiry, that this substance was glycine, which had been dissolved by the excess of carbonate of ammonia.

b. The Silica being removed, the sulphuric acid, formed by the action of nitro-muriatic acid, was thrown down by nitrate of barytes. The sulphate of barytes weighed after ignition 0,7063 gr. = 0.097442 gr. of sulphur = 5.057 per cent. of sulphur.

c. The barytes in excess being precipitated by sulphuric acid, and the sulphate of barytes removed by the filtre, the liquid was evaporated in a porcelain dish. It became first red, then green, whereby nitrous vapours were disengaged. Having been evaporated almost to dryness, a white powder separated by addition of water, which was entirely dissolved by an additional quantity of sulphuric acid. The sulphuric acid solution was now decomposed by ammonia, and the precipitate put upon a filtre. The liquor, which had passed quite clear, became troubled by degrees, and assumed a brownish hue; it was concentrated by evaporation, whereby the excess of ammonia was expelled, and the oxide of manganese collected upon a filtre. It weighed after ignition 0.0604 gr. = 2.824 p. c. Oxalate of ammonia afforded no precipitate in the filtered solution, a proof of the absence of lime; hydrosulphuret of ammonia precipitated sulphuret of manganese, which was dissolved in muriatic acid, and joined to the solution of manganese obtained below. The liquid was now evaporated and ignited; but there remained in the crucible nothing but a slight trace of manganese, which was dissolved by oil of vitriol with red colour; by muriatic acid with disengagement of chlorine, and whose solution likewise was joined to the solution of manganese obtained below.

d. The precipitate is still to be examined, which was thrown down by caustic ammonia (in *c*). It was dissolved in muriatic acid, the solution evaporated, in order to expel the acid in excess, then boiled with a solution of pure potash. The brown residue left was dissolved in muriatic acid with disengagement of much chlorine; from this solution the iron was thrown down by succinate of ammonia. 0.119 gr. of oxide of iron were obtained = 8.564 p. c. of protoxide.

e. The liquor from which the iron had been removed, joined with that (in *c.*) obtained by the decomposition of sulphuret of manganese, was thrown down by boiling with a solution of subcarbonate of potash. The oxide of manganese weighed after ignition was 0.865 gr. =0.77945 gr. of the protoxide =40.449 p.c. In case that the sulphur of Helvine is combined with manganese to a sulphuret (which is very probable, the iron being at any rate not sufficient to saturate the sulphur), from the 0.77945 gr. of protoxide of manganese, 0.22076 gr. (corresponding to 0.17233 gr. of metallic manganese, which saturate the 0.097442 of sulphur) must be deducted. There remain, then, 0.55869 gr. protoxide of manganese = 28.993 p. c. and the whole quantity of protoxide of manganese amounts to 31.817 p. c. At the same time we obtain for the sulphuret of manganese 0.26977 gr. = 14.000 p. c.

f. The alkaline lixivium, separated from the brown precipitate (in *d*), was supersaturated by muriatic acid, and the liquid then thrown down by a small excess of carbonate of ammonia. A white earth fell down, which, after ignition, weighed 0.1988 gr. = 10.161 p. c. The liquor separated by the filtre from this precipitate deposited after some time a white precipitate; it was, therefore, evaporated together with the wash-water, and the precipitate collected upon a filtre. It weighed after ignition 0.036 gr. = 1.868 p. c. As it was found afterwards, that this precipitate, and the earth already mentioned, were one and the same substance, the whole quantity of the earth obtained amounts to 12.029 p. c.

g. 1.039 Grammes of Helvine left after ignition 1.027 gr.; 100 p. would therefore lose 1.155 p. c.

The *nature* of that earth is established by the following experiments:

It is not changed before the blow-pipe, nor does it become yellow by heating. It is dissolved by borax and salt of phosphorus in large quantity, and yields a clear glass, which becomes milky by flaming; by a large addition to these fluxes, the glass becomes milky by itself when cooling. It is not acted upon by soda, nor is there formed a white ring surrounding the assay; when heated with nitrate of cobalt, a blackish grey mass is obtained. The solution of this earth in acids is thrown down by carbonate of ammonia, the precipitate is almost entirely dissolved by an excess of it, leaving behind a little alumine not perfectly pure, forming alum with sulphuric acid and potash; from the ammoniacal liquid the earth separates by boiling as a *light flocculent* powder, which, when washed upon a filtre with boiling water, is dissolved by acids with *effervescence*, and forms no alum with sulphuric acid and potash. This earth is likewise dissolved by a solution of subcarbonate of potash, when it is precipitated from its solutions by an excess of this salt, and the liquor boiled. When this earth is precipitated from its solutions by caustic ammonia, and this alkali is added in a *very great excess*, almost no perceptible quantity of it is dissolved, which falls down again, when the excess of ammonia is expelled by heat. With an excess of muriatic acid a mass not distinctly crystallized is formed during evaporation, which deliquesces in the air, and is decomposed by heat in muriatic acid and earth that is left. This muriate has a very sweet, and at the same time an astringent, and not metallic taste. Combined with sulphuric acid it crystallizes by a slow evaporation, when the acid is only added in the quantity required for its solution. The sulphate has an acrid taste; it is decomposed by a moderate ignition; only a small portion of the residue is dissolved in water; by far the greatest part is left undissolved, in the form of a mucilaginous substance.

In acetic acid this earth is dissolved, the solution does not crystallize by evaporation; by a slow evaporation a gummy-like transparent mass is formed, which does not attract humidity of the air, becomes full of cracks, and dissolves anew in water; by a quicker evaporation the residue becomes in part milky. Sulphuretted hydrogen forms no precipitate in the solutions of this earth. Caustic potash dissolves it, as it appears already from the analysis.

This earth is therefore *glycine*, mixed with a very small quantity of alumine, and helvine is composed of—

		Containing Oxygen.
Silica, - -	33.258 (*a*)	16.73
Glycine, with a little alumine,	12.029 (*b*)	3.75
Oxide of manganese, -	31.817 (*c*)	6.98
Oxide of iron, - -	5.564 (*d*)	1.27
Sulphuret of manganese, -	14.000 (*e*)	
Loss by ignition, - -	1.155 (*g*)	
	97.823	

Experiments for ascertaining the Existence of Fluoric Acid in Helvine.—*a*, 1.605 grains of powdered helvine were mixed with three times their weight of carbonate of soda and ignited. A black fused mass was obtained, showing on the edges a reddish-yellow hue. Water, when digested with this mass, was not coloured, nor did it receive any smell; a quite colourless liquor was formed, and a black powder was left, which was lixiviated upon a filtre by boiling water. The liquid which had passed through the filtre was rendered somewhat troubled by digestion with carbonate of ammonia, and the precipitate thrown upon the same filtre. The liquor being now supersaturated by muriatic acid, and after expulsion of carbonic acid in a moderate heat, mixed with caustic ammonia and muriate of lime in a well-closed bottle, no sensible precipitate was formed; a proof of the presence of fluoric acid. *b*, The black powder was dissolved in muriatic acid. There was evolved at first a sensible smell of sulphuretted hydrogen, which was soon displaced by a strong smell of chlorine; a pellicle of sulphur appeared at the same time upon the liquor. The muriatic solution was evaporated to dryness, and silica separated, which after ignition weighed 0.5661 gr.=35.271 p.c. *c*, The fluid was then boiled with an excess of a solution of pure potash; the alkaline liquor separated by the filtre from the brown precipitate, supersaturated by muriatic acid, and precipitated by caustic ammonia. The glycine weighed after ignition 0.1482 gr. = 9.234 p. c. It was dissolved in muriatic acid, and the solution put in digestion with an excess of carbonate of ammonia. A white earth was left undissolved, which, even by a much larger quantity of carbonate of ammonia, was not taken up, and which after ignition weighed 0.0232 gr. = 1.445 p. c. When dissolved in sulphuric acid, and mixed with sulphate of potash, two small crystals of alum were formed. Nevertheless this earth was not pure alumine, for it produced, when treated with nitrate of cobalt before the blow-pipe, not that fine blue colour, which characterises pure alumine, but became, on the contrary, bluish-black, and this colour was scarcely to be distinguished from that afforded by pure glycine with this metallic salt. It seems, therefore, that a certain quantity of glycine in chemical combination with alumine is retained by this latter, whereby the reaction with cobalt is almost entirely destroyed. The earth, which was dissolved by carbonate of ammonia, proved to be pure glycine. When dissolved in sulphuric acid, and mixed with sulphate of potash, there was formed no trace of alum. Alumine, on the other side, being a little soluble in a considerable excess of carbonate of ammonia, it seems, in the present case, to have likewise left its solubility in this menstruum, by its chemical combination with glycine, in the same manner as it, at least partly, loses its solubility in pure potash by its chemical combination with magnesia. *d*, The brown precipitate (in *c.*) was dissolved in muriatic acid, whereby chlorine was evolved. From this solution the iron was precipitated by succinate of ammonia, and 0.1425 gr. of oxide of iron obtained = 0.12825 gr. of protoxide = 7.990 p. c. *e*, The liquor was then precipitated by an excess of subcarbonate of potash, 0.7267 gr. of oxide of manganese were obtained = 0.65484 gr. of protoxide = 40.800 p. c. This oxide was dissolved in muriatic acid, the solution rendered neutral by evaporation, precipitated by a hydrosulphuret of ammonia. The liquor separated by the filtre from the sulphuret of manganese, and evaporated in order to drive off the excess of the hydrosulphuret, was boiled with a solution of subcarbonate of potash; but no precipitate fell down. *f*, The carbonate of potash (in *e.*) having been supersaturated by muriatic acid, and the carbonic acid expelled by heat, there was formed a small precipitate by caustic ammonia, which, collected upon a filtre and ignited, weighed 0.0038 gr. = 0.237 p. c., and examined by nitrate of cobalt, proved to be glycine. *g*, According to the first analysis, 100 p. of helvine contain 14 p. of sulphuret of manganese, which must therefore be deducted from the 40.8 p. c.; and helvine is according to the analysis composed of—

		Containing Oxygen.
Silica,	35.271 (*b*)	17.75
Glycine,	8.026 (*c* and *f*)	2.50
Alumine, with some glycine,	1.445 (*c*)	0.67
Oxide of manganese,	29.44 (*e* and *g*)	6.43
Oxide of iron,	7.990 (*d*)	1.82
Sulphuret of manganese,	14.000	
Loss by ignition,	1.55	
	97.231	

The loss, somewhat considerable, which occurred in both analyses, may be justified partly by the small quantity of the substance subjected to analysis, partly by the difficulty which is met with in the exact determination of the protoxide of manganese. It is, indeed, very probable, that manganese is contained in this mineral in the form of protoxide, because otherwise no such considerable disengagement of sulphuretted hydrogen should take place, when the mineral is treated with muriatic acid. But the oxide of manganese obtained by the ignition of the carbonate had been reckoned black oxide, though under these circumstances a certain quantity of the red oxide might have been formed, in which case, the quantity of manganese would have been underrated. The great quantity of oxide of manganese contained in helvine satisfactorily explains why the sulphur contained in this mineral had escaped Dr Vogel, because this oxide is superoxidated when the fossil is ignited with potash, whereby the sulphuretted hydrogen, disengaged by muriatic acid that is poured upon the ignited mass, is immediately decomposed by chlorine, which is evolved at the same time.

The results of these analyses of helvine are such, that this mineral will scarcely be placed hereafter close to garnet. It appears, besides, not to be possible to decide what the chemical composition of helvine may be, when it is considered, that scarcely an analogous composition had been hitherto discovered amongst minerals. It might be, perhaps, regarded as a combination of double-silicates of oxide of manganese and glycine, with an oxysulphuret of manganese; the results, particularly those of the second analysis, are not unfavourable to this view. But I consider this as a mere conjecture, as the rarity of the mineral has hitherto not allowed me to examine it to such an extent as I could have wished.

ART. XVII.—*Additional Observations on the Natural History and Physical Geography of the Himalayah Mountains, between the River-Beds of the Jumna and the Sutluj.*[*]

By GEORGE GOVAN, M. D. Communicated by the Author.

IN the paper which I had the honour of laying before the Society a short time ago, my remarks upon the Physical Geography of certain districts in the Himalayah Mountains closed, at what may be considered by some as the most elevated points of the transition limestone of the Sein range. In order, however, to avoid as much as possible that hypothetical language to which the appearances presenting themselves can hardly fail strongly to incline an observer, we may merely mention, that these remarks applied to the first of the divisions, into which the districts under consideration (with reference to geological structure) seem naturally to arrange themselves, viz. the belt of somewhat parallel ranges about fifteen or twenty miles in breadth, next adjacent to the plain of Upper Hindostan, the rocky masses composing which are of a much less compact and more earthy structure than those of the succeeding divisions, upon which they may be observed to rest at different points, elevated from five to about seven thousand feet above the level of the sea. A subdivision of this may perhaps be made at Nahun, where the sandstone becomes perfectly durable and hard, of a dark grey colour, with dark purple maculæ, besides losing all traces of carbonaceous matter. The next divisions are, 1*st*, The central mountain groupe of the *Choor*. 2*d*, The *high snowy ridge*, and the ranges proceeding from it. A marked difference subsists betwixt the two last mentioned tracts, and that formerly treated of, in the luxuriance of their vegetation, being much better wooded, in many places, with noble trees of the largest dimensions, particularly three new species of pine, the *Kail*,[†] resembling the Weymouth,—the *Khutrow*, analogous to some of the varieties of the spruce,—the *Pindrow* to the Yew-leaved

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[*] Read before the Royal Society of Edinburgh, December 20, 1824.

[†] The seeds of the *Kail* are those which have succeeded most readily in the climate of Great Britain, and have now been raised in considerable number.

Pine, the latter always occupying the loftiest belt along with the *Kurso*, a species of Quercus, the Rheum, Juniperus, a second species of Rhododendron, the Birch and Sorbus, which two last trees here, as in the high lands of other countries, are generally found the most elevated, and in a stunted shape, the last arboreous forms of which we take leave in ascending to the region of snow and desolation.

A vast variety of northern genera here present themselves,[*] never before known to exist in such close proximity to the arid plains of Hindostan; and the labours of Dr Wallich, it is to be hoped, may soon enable botanists to compare the Asiatic with the European and American species so closely allied to them, if not in many cases varieties merely. Towards the summits, and on the N. E., or Tartarian face of the snowy ridge, many genera and species closely allied to the Siberian begin to make their appearance.

All the peculiarities of hill vegetation and agriculture are, in the lower part of this belt, fully developed.

Three species of *Polygonum*, known by the native names of *Paphra*, *Ogla*, and *Chabree*, with the frumentaceous *Amaranthus*, furnish the most common grains, besides wheat, and the valuable six-sided naked barley, called *Ooa*.[†]

Opium, from the facility of its transportation, here, the most valuable of all properties, as well as its superior quality, at the elevation of 8000 feet, is often spoken of as the only production in some of the interior states, of which the exportation to the plains enables them to pay their government's assessment, the small bulk which it occupies setting at defiance all revenue regulations for its exclusion.

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[*] Among these may be enumerated many species of

Morina, 1 Sp.
Trillium.
Frittillaria.
Fumaria.
Convallaria.
Impatiens, (some of them gigantic in size.)
Polemonium.
Gentiana.
Galium.
Fragaria.
Rubia.

Lilium.
Hemerocallis.
Androsace.
Valeriana.
Salvia.
Euonymus.
Viburnum.
Lonicera.
Cratægus.
Mespilus.
Laurus.
Daphne.
Cystus.

Spiræa.
Rubus.
Ribes.
Rosa.
Ilex.
Cornus.
Olea.
Æsculus.
Clematis.
Corylus.
Pinus.
Aconitum.
Atragene.

Ulmus.
Fraxinus.
Alnus.
Coriaria.
Andromeda.
Acer.
Astrantia.
Cnicus.
Paris.
Hypericum.
Pedicularis.
Quercus.
Delphinium.

[†] Since introduced into Scotland.

Tobacco can no longer be cultivated with advantage here, as the plant, although it thrives luxuriantly, is quite superseded by the superior quality of that imported from the plains. In anticipation of details, which, under favourable circumstances, I hope at some future period to be able to lay before the Society, I shall submit a few general observations upon the geology of the districts, included under the two divisions above mentioned; if mere notices respecting the surface rocks, occurring at different parts, with the elevation of their outgoings, are entitled to that appellation.

Bundur Pooch and *Sirga Rohini* are the loftiest summits of the snowy ridge here which I have seen.

From these the *Ganges*, the *Jumna*, the *Tonse*, originate to proceed southerly, and various feeders of the Sutluj in a northerly direction.

The country between them, and towards the Sutluj, as viewed from the summit of the Manjhee ridge, between the sources of the *Jumna* and *Tonse*, seems an extensive and inaccessible waste of thickly grouped snowy summits, where one would hardly imagine a living thing could exist. As the streams descend, however, and their beds become more warm and sheltered, a thinly scattered population occupies their sides, immersed in filth, ignorance, and superstition, earning a scanty and precarious subsistence by the cultivation of some of the crops previously noticed, in artificial flats about the village, by the transportation to the plains, or neighbouring states, without any convenience from roads, or beasts of burden, of some of their vegetable or mineral productions, but chiefly by the produce of numerous flocks of sheep and goats, which are driven to pasture higher and higher, as the melting of the snows in spring leaves behind it a green and tender herbage, and which again gradually descend lower as the southing of the sun embrowns the surface by admitting the gradual prevalence of nightly frosts.

The same rapidity of vegetation which distinguishes the summer of the polar regions, soon covers these upland pastures with a thick and luxuriant drapery of beautifully flowering plants, Anemones, Potentillæ, Primulæ, Dryas, &c. &c., on the spots occupied by the snow-beds;—the solvent properties of the snow seeming to favour the formation of that rich black mould in which these plants chiefly flourish. *

The wooden galleries surrounding the upper flats of the slate and shingle-roofed houses are, during the summer, stored with grass drying for the winter subsistence of the diminutive breed of cows, and of the flocks which occupy, during the cold season, the ground floor, as, in the vicinity of many of these villages, the snow lies from two to four months in the year, giving promise, by the quantity in which it falls, of a proportionably abundant wheat harvest.

The returns of wheat,† indeed, are said in many of these villages generally to equal, and often to exceed, those from many of the best wheat lands in the plains of the upper provinces, under the influence of liberal manuring, with composts formed of oak leaves, snow, and the dung of the sheep and goats.

The line of snowy summits, stretching in a north-westerly direction to Wangtoo, from 40 to 50 miles direct distance, with passes from the southerly to the northerly face, elevated from 15,000 to 16,000 feet above the level of the sea, has its vertical summits eternally clothed with snow, where one would not imagine, from the erectness of the plainward faces, any moveable substance could rest, and is, of course, at most places altogether inaccessible. The Rol pass, which I crossed on the 25th September 1817, may perhaps be formed by the decomposition of a bed of *White Feldspar*, of which immense tabular masses hurled from above occupy the bed of its northern river, the Shatooltee. The summits on either side are not of *Granite*, but of a grey

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* A most remarkable natural provision for their defence against the inclemency of the weather to which they are exposed, is displayed by some of the plants inhabiting these elevated regions, an elongation of their lower leaves, which become clothed with a dense lanuginous or cottony investiture, and rise to form, by their junction, an arch over the tender flowers. The same plants, occurring in other situations, have none of this.

† From 7 seer of seed, 160 seer of produce is frequently obtained; it is asserted a seer is about 2 pounds.

Gneiss, of which the foliated structure is chiefly observable in the large or weathered masses, having black mica, and a porphyritic appearance from longitudinally imbedded masses of *Feldspar* of a dirty white. An alternate flux and reflux of the waste of milky vapour, constantly going on between the northerly and southerly face through the gorge of the pass, at certain seasons, evinces the striking effects which these elevated summits must necessarily produce on the meteorology of the sultry and arid plains to which they adjoin.

Where the Sutluj emerges from behind this range, and washes its base at Wangtoo, its bed is formed in a small grained, compact, grey granite, smoothed by the water's attrition; but from which, (owing to its durability,) no specimen could be broken by any common means; in this are to be seen occasionally large veins indissolubly united with the rock itself, in which all the granitic ingredients are separately crystallized,—the feldspar, the chief ingredient, of a snowy white,—the mica in large separate flakes, quartz, and occasionally *Schorl* in smaller quantity, these may be seen to pass through the superincumbent black micaceous schistus, without, however, seeming to produce either derangement of position, or altered structure.

I have observed horizontal sandstone stratification upon the face of this range to an elevation of between 7500 and 8500 feet.

The little flat (small compared to the surrounding mountainous country) where the Jumna leaves the main range round about the village of Kursālee, from the depth of its alluvial soil, and the narrow pass at the lower extremity, surrounded with horizontal strata, bears the appearance, often remarked, of having been a lake which had burst a boundary, within which, for a time, it had been contained.

The chains proceeding in south-westerly directions from the main range, on the extremities of which the minerals of the parallel ranges are superincumbent, are chiefly composed of gneiss, mica, and clay-slate, often seemingly graduating into each other.

The mountain groupe of the Choor, about 12,000 feet above the level of the sea, does not bear snow during the whole year, although snow may almost always be found throughout the year in some of its sheltered chasms. The summit is composed of vast tabular masses of compact *Granite*, very susceptible in many places of decomposition; but not having the granitic materials at all in the same highly crystallized and durable union as the rock of the Sutluj bed.

The vegetable inhabitants are here, in many respects, the same with those of the main range of snowy cliffs, to which it is united by a continuous ridge nearly 8000 feet in elevation at the source of the Girri. On the very summits of the Choor first appear the Juniper, Alpine Rhododendron, and the lofty *Aconite*, the well known poisonous effects of which, when taken internally, seem to have given rise to a belief among the natives, that it poisons the air in its vicinity; an opinion for which I never could discover any foundation, unless it may be found in the lofty elevation of the belt, inhabited by this showy plant, where *occasionally* (certainly not *always* or uniformly) the disagreeable effects usually ascribed to the rarity of the air are experienced by travellers.

If the symptoms noticed by many eminent naturalists, as arising from the rarity of the air, really are to be imputed to that cause, whence comes it, that, like the descent of the mercury, they are not in some degree proportioned to the elevation and rarefaction, and invariably occurring where a certain degree of the latter takes place?

In passing the night at elevations, on two occasions, upwards of 14,000 feet above the level of the sea, higher than the summer limit of perpetual snow, and in crossing the Himalayah by the Rol pass, (considerably above 15,000 feet,) they were neither experienced by myself, nor by any individual of a party of forty native soldiers, and attendants accompanying me. Both in these same places, and at other inferior elevations, they have been experienced on other occasions, and were anticipated as probable upon these by the natives.

These facts would rather seem to indicate the phenomena in question being dependant upon some less uniform atmospherical condition, such as the electrical, which, about natural conductors so elevated, must be in a state of constant fluctuation.

Whether the Choor is of contemporaneous or subsequent formation to the range of snowy cliffs, we have no information yet to enable us to guess. It has, radiating from it in all directions, ridges, composed, 1st, of successive strata of mica-slate, some containing precious, some common garnet, imbedded, the latter in imperfect dodecahedral crystals, which I have seen of considerable size.

The mica-slate has also small beds of primitive limestone, some of which form a beautiful marble of large crystalline grain, and snowy whiteness.

The succeeding clay-slate contains a rich iron ore, with *Pyrites*, by the oxygenation of which, probably, we have at many places inexhaustible stores of an impure sulphate of iron, which forms an article of trade with the plains.

Respecting the metallic riches of these districts, I may remark, that *Gold*, although found plentifully in a state of very minute subdivision in the sand of the bed of the Sutluj, has, as yet, been nowhere discovered in its natural situation. *Copper* exists at various places in the clay-slate, and most of the mines have been abandoned. *Galena*, which (I think, generally occurs near the junction of the clay and mica-slate, is worked to a considerable extent) is the chief substance, besides the iron, in which the metallic riches of the country consist. The miners are the least communicative race whom I have encountered in these hills; but I never could learn from any certain authority, that *Silver* was contained, or had been procured from any of the Galena on the plainward face of the Himalayah, although it is said to be brought from some of the Tartarian provinces beyond the Sutluj.

The mines of Galena—partly, I believe, from a desire to keep their history and their value unknown to strangers—partly to enable the miners and the officers of the native government safely to league together, in order to defraud the Rajah of his prescribed share of the produce—partly, perhaps, from ignorance and indolence, are excavated in so slovenly a manner as to be quite inaccessible to any one (at least at two different places where I visited them) except a practised miner among themselves, who, as we have sometimes experienced in military operations, seem to have acquired by habit a power of breathing where only moles or snakes could support existence.

Such are the most common mineral substances of which the country is formed, and which meet the eye on a cursory examination; but numerous subordinate mineral beds exist, hitherto unexplored, and long likely to remain so, unless the energies of the people themselves shall receive a stimulus from their improved circumstances under our government.

The personal exertions of the daily journey form a labour amply sufficient for any one merely passing through the country, along foot-paths winding round the edges of precipices, descents into deep and sultry river courses, painful and fatiguing ascents to places which seem near, and yet requiring almost a day's journey to reach; and a minute and accurate knowledge of the structure of the country will never be acquired by any one who has not zeal sufficient to induce him to leave behind all heavy baggage, adapt himself as much as possible to the simple diet of the natives, and continue to prosecute his researches from some fixed point, with as few followers as possible, the country being incapable, in many places, of furnishing supplies for the retinue with which European officers usually travel.

In the plains of Hindostan, it has been often remarked, that it is almost impossible for the European officer to have much personal acquaintance either with the social character or domestic habits of the natives. Much mutual misapprehension is apt to exist between those who meet only in public—who only feel mutual sympathy on some great occasions of common danger or display. The customs of eastern countries admit only of the most public parts of the hospitable roof being accessible to any but the nearest of blood relations. The non-observance of the Mosaic ritual separates the European from the Mahomedan; the doctrine of Caste from the Hindoo; a certain degree of contempt, in which it is alleged the British, more than other European nations, hold the fashions of those whose customs differ from their own, equally alienate him from both, in such social intercourse as their different situations might otherwise admit of their holding.

Even the rude, though not indecorous, simplicity of the most respectful behaviour in the inferior towards his superior (recalling the memory of Scriptural and Homeric times) is not always understood as it is meant, by those lately transported to eastern climes from these more highly favoured northern regions. The climate of the plains, too, so hostile to the constitution of the European, by confining him much to the house, renders it impossible he should see much of the native, except in the field, upon parade, as a domestic servant, or in some subordinate office of the law or revenue departments, in all of which, except perhaps the first, he appears in an artificial and acquired character.

In the hill districts, most of these obstacles, to a close observation of the native character, have less influence.

Those peculiarities of diet, purification, and discipline, by which the Hindoo is alienated from every other human being, are here adhered to with much less pertinacity than in the plains, where the fashions and superstitions of an aboriginal race, the occupants of the soil, previous to their acquaintance with their earliest conquerors or teachers of civilization, the Hindoos of the plains, seem still to be more or less prevalent. The climate, too, above 8000 feet of elevation above the level of the sea, is generally sufficiently cool to admit of a European spending much of his time in the open air during the day; and among the hill Sepoys, formerly in the pay of the Gorkhali, one can find zealous associates, in many of the sports of the field, possessing more of the activity and good humoured hardihood of the best style of European soldier than the dignified and phlegmatic, though respectful, disposition of the rajpoot of the plains, who would seldom, probably, from inclination, or for his own amusement, think of seeking with alacrity to join in pursuit of the pheasant, the hill partridge, the bear, or the hyena.

The occasional inclemency of the weather, and the difficulty of conveying tents at all suited to resist its severity, often unites all ranks and classes under one roof in the village, in the portico of the Deota's temple, or under the friendly shelter of the cavern around the blazing pine-wood fire. When the native taste is here allowed to display itself unrestrained in conversation among each other, features of character make their appearance, which years of a cantonment life in the plains never would have brought into notice.

The Mahomedan fictitious narrative, abounding, after the manner of the Arabian Tales, with gorgeous and glittering palaces, princes, princesses, fairies, magicians, and Genii, de-lights the listening audience; the dark and gloomy legends of the Hindoo mythology succeed, related perhaps by the wandering religious mendicant, often seemingly in character a most unintelligible compound of knavery, enthusiasm, and insanity, whom the most exalted in rank, the most elevated above popular prejudices among his countrymen hardly dares to offend, or even to exclude from notice and charity even in his most uncouth form. He finds his way, and seems to meet with a welcome everywhere, the carrier of intelligence between Juggurnauth and Cape Comorin, and Astrachan or Siberia; the established medium of communication between hostile armies, spy to both parties, faithful to neither; equally acquainted often with what passes in the interior of private families, in defiance of all the obstacles which Eastern jealousy has devised to render such knowledge almost impossible; under these circumstances often the plausible pretender to supernatural powers, himself, perhaps, sometimes believing in his possession of that to which he habitually lays claim.

The itinerant minstrel sometimes furnishes more agreeable subjects of human interest, when he sings of the lofty and independent spirit of the rajpoot chieftains of old, at the period of the early invasion of Hindostan by the Mahomedans, their undaunted valour, their chivalrous readiness to abandon life and all it has to give, when any thing inconsistent with honour was required of them.

The observations called forth, and the discussions which ensue upon these occasions, often afford a rich field for speculation to any one delighting in the study of the human mind, and the observation of human character in its most varied forms and circumstances.

In few places, however, is there any thing in the civil and moral history of the country to bear us out in the analogy which the mind would so much delight in establishing between these states and the European Alpine districts, whose hardy natives probably are occupied in pursuits not dissimilar, and inhabit a country equally abounding in sublime scenery and the grandest of natural objects.

The absence of all the domestic charities under the system respecting females, formerly alluded to, the irregular calls for the exertion of industry, with intervals of listless indolence, necessarily resulting from the insecurity of its acquirements and obstruction in the channels of their exchange and distribution; lastly, the dominion of a dark, gloomy, and debasing superstition, seem to be the sources of most of the evils under which they labour. Under such circumstances, their wars among each other seem to have been merely bloody and ferocious, displaying but rarely instances of that generous emulation in hardy enterprise, by which those of many nations but little advanced in civilization have been occasionally distinguished.

The character which the British Government shall acquire and maintain by the policy pursued towards these hill states, (many of which hailed its ascendancy as a deliverance,) will be spread far and wide among the extensive, though yet but little known population of Central Asia, and in no situation will the liberal principles of British administration, and that desire of bettering the condition, both civil and moral, of the body of the people, by which our policy is so honourably distinguished, be more apt to be duly appreciated than where our protection has succeeded to the sway of a body of needy and rapacious adventurers.

ART. XVIII.—*Analysis of Diploite*, * (Breithaupt.) By C. G. GMELIN, Professor of Chemistry in the University of Tübingen. Communicated by the Author.

THIS mineral was given to Mr Breithaupt by Dr Thalacker in Herrenhut. It occurs upon the island Amitok, near the coast of Labrador, and forms, with carbonate of lime, mica, and feldspar, a heterogeneous mixture, which probably belongs to the primitive rocks.

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* This mineral is undoubtedly the same to which Mr Brooke (*Annals of Philosophy, May* 1823, p. 383) has given the name of *Latrobite*. As the latrobite, according to Mr Brooke, has cleavages in three directions, the name Diploite, which relates to its having two cleavages, is perhaps not quite suitable. This mineral has, according to Mr Brooke, three cleavages parallel to the lateral and laminal planes of a doubly oblique prism. The cleavage parallel to the terminal plane is very dull, and the measurement obtained from it not to be confidently relied on. It forms angles with the lateral cleavages of about 98° 30′ and 91°. The cleavages parallel to the lateral planes form an angle of 93° 30′.

Characteristic according to Mr BREITHAUPT.—*Lustre* vitreous, passing to pearly upon the most perfect cleavage. *Colour* rose and peach-blossom red. *Rhombic. Massive,* and coarsely disseminated. Has cleavages in two directions, the one distinct, the other less so, forming with the former an angle of about 95°. *Hardness* 6.5 to 7. *Specific Gravity* 2.72, (according to Mr Brooke about 2.8.)*

Relations before the Blow-pipe.—Before the blow-pipe it loses its colour, becomes snow-white, swells up, and melts on the edges to a little transparent mass, full of bubbles. With salt of phosphorus, it melts to a clear glass, containing a skeleton of silica; with borax, to a colourless glass. With soda, it melts to a white glass, a little transparent, which, by an additional quantity of soda, becomes less fusible. Upon a platinum lamina, the manganese reaction appears.

I shall only give the results of two analyses to which diploite was subjected.

	The Analysis with Carbonate of Barytes afforded—	The Analysis with Carbonate of Potash—
Silica, -	44.653	41.780
Alumine, -	36.814	32.827
Lime, -	8.291	9.787
Oxide of manganese,	3.160	5.767 (with a little magnesia.)
Magnesia, with some manganese, -	0.628	
Potash, -	6.575	6.575
Water, -	2.041	2.041
	102.162	98.777

For the analysis with barytes 1.776 gr. and for that with potash 0.815 gr. were expended. A particular analysis was besides instituted to ascertain whether fluoric acid is an ingredient of diploite; but, as not more than 0.2 gr. could be expended, the negative result, that has been obtained, cannot be considered as a decisive one. Perhaps the formula $\left.\begin{matrix}\mathrm{K}\\ \mathrm{C}\end{matrix}\right\}\mathrm{S}+5\mathrm{AS}$, or $\mathrm{KS} + 2\mathrm{CS} + 15\mathrm{AS}$ might represent the composition of diploite. Hence the opinion of Mr Breithaupt, that diploite is nearly related to feldspar and scapolite, is confirmed *also by chemical results.*

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* This is equivalent to 5.25—5.5 in the scale of Mohs, between Apatite and Actynolite, but nearer the latter.—ED.

Art. XIX.—*Description of a New Double Valve Sluice.* Invented by Robert Thom, Esq. Rothesay. Communicated by the Author.

The Double Valve Sluice. Plate IV. *Figure* 5.

This apparatus seems to answer the same purpose as the lever sluice already described in this volume, p. 100; but is more applicable in cases where the reservoir is deep, and the embankment consequently large. It also acts as a waster-sluice, by opening and passing the extra water whenever it rises in the reservoir the least above the height assigned, and thereby supersedes a bye-wash.

In making hydraulic experiments it will also be found of considerable importance; as, by keeping the surface of the water in the cistern, from which we draw water for the experiments, always exactly at the same height, it not only saves intricate calculations, but renders the result, upon the whole, more correct.

AB, a tunnel through which the water flows from the reservoir to

BC, the aqueduct that conveys it to the mills.

AD, a sluice that turns upon pivots at the upper side D.

I, a lever attached to that sluice, of the same length from I to D as from D to A.

EF, a hollow cylinder.

GH, another cylinder, (water proof, and of rather less specific gravity than water,) which moves up and down freely within the cylinder EF.

IBG, a chain, one end of which is fixed to the lever I, and thence passing over pulleys B and J, has its other end fixed to the cylinder GH at G.

KL, a cistern always full of water, being supplied by a spring.

LMF, a pipe that communicates between the cistern KL and the cylinder EF.

NO, a spindle with two valves, O and N, fixed upon it.

P, a float that rises and falls with the water in the aqueduct BC.

The water in the aqueduct is here represented at its greatest height; the sluice AD and valve N being shut, and the valve O open.

Suppose, now, that water is drawn from the aqueduct, the float P will fall with the water, and leave the spindle NO, which, then falling by its own weight, shuts the valve O, and opens the valve N. The water then passing from the cistern KL, into the cylinder EF, raises the cylinder GH; and then the pressure of the water in front of the sluice AD, throws it open. Again, when the water issuing from the aqueduct is stopped, its surface rises, and with it the float P, which, pushing up the spindle ON, shuts the valve N, and opens the valve O, when the water in the cylinder EF escapes; and then the cylinder GH falling, shuts the sluice AD as before. In this way, the surface of the water in the aqueduct is always kept at the same level, whether the quantity drawn from it be great or small.

In order to make this sluice operate also as a waster, it is only necessary to have a tube communicating between the reservoir and cylinder EF, the end of which that opens into the reservoir being placed at the greatest height to which the water therein is allowed to rise.

Whenever the water in the reservoir rises so as to flow into this tube, the cylinder EF will be filled with water, and the sluice AD will open; and whenever the water again falls, so as not to flow into this tube, the sluice AD will shut, and act again as before. This tube must, of course, be made to pass more water than the valve O can pass.

An apparatus of this construction was erected at Rothesay in 1819, and has been in constant operation ever since. The cylinder EF is four feet one inch diameter, and five feet deep inside.

The cylinder GH is four feet diameter, and four feet deep over all.

Float P, about two feet square, and six inches deep.

Valves O and N, two inches diameter.

Pulleys B and J, twenty inches diameter.

Sluice AD, four feet long, and six inches deep; but the cylinders, &c. are powerful enough to work one of nearly twice that area.

Thus, the area of the sluice is two feet; depth of water above the centre of the sluice, twenty feet; of course, there are forty cubic feet of water pressing upon the sluice; but one-half of this is borne by the pivots, at its upperside. Were the specific gravity of the cylinder GH the same as that of water, this would leave only twenty feet for its contents; but, to make it float freely, it is one-twentieth less; therefore, allowing one foot more for this, and three feet for friction, twenty-four cubic feet would be the necessary contents of the cylinder GH;—but its contents are fifty cubic feet: it was made thus powerful, that it might work a larger sluice, if ever it should be found necessary. For an improved construction of this apparatus, see Fig. 5.

PLATE IV. *Figure* 6.

This apparatus is applicable to the same purposes as that of Fig. 5; but the construction is much simplified.

A, the sluice, which turns upon pivots at its centre of pressure.

AB, a lever attached to that sluice, which, with the small weight B at its extremity, is heavy enough to overcome the friction of the sluice, and keep it shut.

AC, the aqueduct that conveys the water from the reservoir to the works.

D, a pulley which turns easily round its axis.

E, a light hollow cylinder of copper, having a very small aperture in its bottom, and open at top.

BDE, a chain, one end of which is fixed to the lever at B, then, passing over pulley D, has its other end fixed to cylinder E.

F, a cistern, always full of water, being supplied by a spring from the rising ground.

FG, a pipe which communicates between that cistern and cylinder E.

H, a valve that opens or shuts that communication.

I, a float, that rises and falls with the water in the aqueduct.

The sluice A is here represented shut, and the water in the aqueduct at rest. But suppose a part of the water to be drawn from the aqueduct, then, as its surface falls, so will float I, which then leaving the spindle of valve H, that valve opens, and the water flows from cistern F into cylinder E, which, when full, descends, raises lever BA, and opens the sluice. Again, suppose the water to rise in the aqueduct, the float I rising with it, shuts valve H, when cylinder E is emptied by the small aperture in its bottom, and the weight of lever AB again shuts the sluice. This sluice also acts as a waster, by having a pipe to communicate between the reservoir and cylinder E, in the same manner as in Fig. 4.

A sluice of this description was erected at Rothesay in 1821. Sluice A is three feet long, and eighteen inches deep; lever AB, three feet long; cylinder E, two and a half feet diameter, and the same depth. The depth of water above the centre of the sluice, when the reservoir is full, is twenty feet.

By this contrivance, of making the sluice turn on its centre of pressure, the weight of the column of water resting on it is neutralised; it being at the same time equally exerted to open and shut the sluice. The acting power has, therefore, only to overcome the friction, to make it move in any direction; whereas, in the apparatus Fig. 4, the power must not only overcome the friction, but must also be equal to half the weight of the whole column of water pressing upon the sluice.*

Thus, in the present case, there is a column of ninety cubic feet of water pressing upon the sluice when the reservoir is full. Were the sluice hinged upon one side, as in Fig 4, it would require the cylinder E to contain forty-five cubic feet of water, besides about one-tenth more for friction; and the chain, lever, &c. would have to be made strong in proportion. But by this contrivance, the power to act against this forty-five feet of water is wholly saved, and the cylinder requires only to contain water sufficient to overcome the friction.

The apparatus is also simplified by having only one cylinder and one valve, instead of two of each, as in Fig. 4. But this plan has also some small disadvantages:—the sluice, when it turns upon pivots at its centre, is more difficult to make water-tight than when it turns on pivots at one edge; nor does the same aperture pass an equal quantity of water; for, besides the space occupied by the sluice in the centre, it also tends to disturb the regular flow or current of the water. In all cases, however, where the sluice is large, and the reservoir deep, there will be a considerable saving in its construction.

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* The other half is borne by the pivots on which the sluice turns. When the sluice is hinged at the upper side, the power has rather more than half the weight to sustain, and when hinged at the under side, it has rather less; but where the depth of the sluice bears so small a proportion to the depth of water above it, the difference is not worth noticing in practice.

ART. XX.—*On the Force exerted by Hydrostatic Pressure in Bramah's Presses; and on the resisting Power of the Metal, with Rules for computing the thickness of the same for different Pressures.*[*] By PETER BARLOW, Esq. F. R. S. of the Royal Military Academy, Woolwich. Communicated by the Author.

THIS paper commences by an examination of the amount of the strain exerted in the circumference of the cylinders in consequence of any given internal pressure, and the result, although somewhat differently obtained, is the same as was first determined by Mariotte, viz. " The circumferential strain, on any given point of the interior of the cylinder, is equal to the pressure of a square inch multiplied by the number of inches in the radius." That is, the force tending to rend the cylinder along any line parallel to its axis, is equal to the pressure on a section between the circumference and axis. This, as we have said, is the result which has always been deduced by writers on this subject; but in estimating the thickness necessary to resist this strain, it has universally been supposed that all the metal in the thickness opposed an equally resisting power; from which it resulted, that in presses of the same internal diameter, the thickness ought to be proportional to the pressure. This principle, however, is known to fail in practice, it having always been found requisite to increase the thickness in a higher ratio than the pressure, and it was principally with a view to correct this error, that the author undertook the investigation, at the earnest request of some of his practical friends, and having completed it, it has been

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[*] This Article is an abstract of a paper read before the Society of CIVIL ENGINEERS, Feb. 22, 1825.

Hence the following rule in words at length.

To find the thickness of metal—Multiply the pressure per square inch by the radius of the cylinder, and divide the product by the difference between the cohesive power of the metal per square inch and the pressure per square inch, and the quotient will be the thickness sought.

As an example, let it be required to determine the thickness of metal in two presses, each 12 inches in diameter, in one of which the pressure is $1\frac{1}{2}$ ton, and in the other 3 tons, per circular inch. The cohesive force of cast iron being 18,000 lbs. per square inch.

Here $1\frac{1}{2}$ ton per circular inch =4,278 lbs. per square inch.
3 tons ditto =8,556 lbs. ditto.

Whence by the rule

$$\frac{4{,}278\times 6}{18{,}000-4{,}278}=1{\cdot}87 \text{ inches thickness,}$$

$$\text{and } \frac{8{,}556\times 6}{18{,}000-8{,}556}=5{\cdot}43 \text{ inches thickness.}$$

Whereas on the usual principle of computation, the one of these thicknesses would be exactly double the other.

Art. XXI.—*On the Acoustic Figures produced by the Vibrations communicated through the Air to Elastic Membranes.*[*]

By M. Felix Savart.

In order to perform the experiments described by M. Savart, we must stretch a thin sheet of paper, about four or five inches in diameter, over the mouth of a vessel, such as a large glass with a foot-stalk, so that the paper has an uniform degree of tension, and a horizontal position. A thin layer of fine and dry sand being then scattered over the paper, a plate of glass, in a state of vibration, is brought within a few inches of the membrane. The vibrations of the glass plate are conveyed

[*] This article is a brief abstract of an elaborate paper by M. Savart, entitled *Recherches sur les Usages de la Membrane du Tympan, et de l'oreille externe,* read to the Academy of Sciences on the 29th April 1822, and printed in the *Ann. de Chim.* tom. xxvi. p. 1.

through the air to the paper membrane, and the sand on its upper surface is thrown into figures which have sometimes the most perfect regularity, and are often formed with such celerity, that the eye has scarcely time to perceive the circumstances which accompany the formation of the figures.

This experiment succeeds in general, whatever be the vibrating body which we employ, though thin plates of glass or metal are the best; and it is always preferable to make the circular plate of glass vibrate in the mode in which there are concentric lines of repose. It appears from the experiments of Chladni, that, in order to obtain this kind of vibration, we must render immoveable several points in the surface of the plate, or at least two points of the circumference and one point of the surface. It is in this way, therefore, that M. Savart makes the experiment. He at first renders immoveable two diametrically opposite points of the circumference of the plate by seizing it between the middle finger and the thumb. He then places lightly the tip of the index finger at a point whose distance from the centre of the plate is about the fifth part of its circumference. The plate, thus held, is made to vibrate by drawing the bow of a fiddle across its circumference. By employing successively circular plates of different dimensions, and which, consequently, give different sounds, it is easy to prove, that, for every number of vibrations, the membrane affects a particular mode of division. When the vibrating plate is parallel to the membrane, the latter performs normal vibrations, or in a line perpendicular to its surface. The sand sometimes springs to a great height; and, by making use of an apparatus which allows us to observe what passes at both surfaces of the membrane, it is easy to see that the distribution of the nodal lines is the same. The general character of these lines is to be circular, and their number is sometimes very considerable. These circular lines are often cut by diametral lines, which form stars, whose number of points increases with the acuteness of the sound. Sometimes figures are obtained which are composed solely of these diametral lines. Perfect regularity and symmetry, however, can only be obtained by taking the greatest care that the membrane be equally thick and uniformly stretched. The first of these conditions may be easily fulfilled by using the finest paper, particularly what is called vegetable paper, which is the most homogeneous that can be employed.

Some of the finest figures that are obtained by the effect of distant vibrations on the membrane are represented in Plate VI. Fig. 1—13. When the membrane is ill stretched, it often happens that the lines traced by the sand are very numerous, and that they form kinds of chains, regularly arranged, and apparently the result of concentric lines cut by a great number of diametral lines. See Fig. 14.

From these experiments it follows, that, when the plate and the membrane are parallel, the motion is communicated by the air exactly as it would have been if the two bodies had been separated by a common rod perpendicular to their faces; for the number of vibrations is the same in both cases; since, for each sound produced, the membrane affects a particular mode of division, and the direction of its motion is also the same, since it is perpendicular in the plate and in the membrane. If the vibrating circular plate is held with one of its diameters in a vertical line, the grains of sand have then a tangential motion, and the system of lines in repose have in general the character of parallelism. By gradually inclining the plate, the figures on the membrane change.

When figures composed of concentric circular lines are obtained, there is often formed between two of these a circular line, composed of the finer particles of the sand. M. Savart is of opinion that this line belongs to a kind of vibration higher than that which is produced, but which co-exists along with the principal vibration. It sometimes happens, also, that the centre of the membrane presents an immoveable point, which probably belongs likewise to a higher mode of vibration, so that the membranes appear to produce with facility several kinds of motion at once.

The preceding experiments may be varied in a great number of ways, by making use of membranes whose dimensions, nature, tension, and contour, are different; but they all present analogous results. The figures produced by a rectangular * membrane are shewn in Plate VI. Fig. 15—21, and those produced by a triangular one in Fig. 22—28. When the diameter of the membranes is less than from half an inch to an inch, it is not easy to observe regular nodal lines, unless when the sound is extremely acute.

The figures which have now been described vary with the tension of the membrane. In those made of paper, which changes its hygrometric state, and consequently its tension, continually, M. Savart observed that the figures changed at every instant. When the same figure is represented several times, it was necessary only to breathe upon the paper to create a new one, which in a short time disappeared, and returned to its former state through a great number of intermediate figures. Hence M. Savart proposes this as a sure method of detecting small hygrometrical variations in the air. In order to protect the paper membranes from the humidity of the air, they should be covered with a thin coat of varnish made of gum lac.

The membranous vibrations and figures which have now been described may also be produced by the sound of the pipe of an organ, even at the distance of some feet. If we play with a slow motion an air on the flute, at about half a foot from the membrane, the sand will form lines, the figure of which varies unceasingly with the sound produced. But, what appears more astonishing, the voice produces an analogous effect, which is extremely well marked, even under the influence of a sound which is neither strong nor sustained. By whatever method, in short, the air is agitated, it is capable of communicating to thin membranes the motion which it has received, and that without any alteration.

These experiments succeed also equally well when the membranes are wetted, or when they have imbibed an oily substance. In this last case, in place of sand, we must cover the membrane with a thin stratum of oil, which is agitated in ripples, which increase in number with the acuteness of the sound.

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* Almost all the figures given by square membranes are analogous to the figure of a square plate, and are almost always of the kind which Mr Chladni calls *distortions*.

M. Savart next applies these principles to a method of appreciating very small quantities of sound. He stretches a piece of thin vegetable paper or goldbeater's skin across the mouth of a glass about four inches in diameter. He then covers this with sand, and ascertains the intensity of different sounds by the distance at which they cease to agitate the membrane; and he remarks that they will often be moved by an augmentation of sound which the ear itself is incapable of appreciating. He proposes also to use it for ascertaining the augmentations of sound which arise from the coincidence of vibrations produced by numbers of vibrations not very distant from each other.

Bodies which are neither rigid in themselves, and which are not rendered rigid by tension, such as the skin, a silken fabric, paper, &c. are, even when they are not stretched, susceptible of being thrown into vibrations by the influence of a body vibrating at a distance; and it appears, that, under some circumstances, they are even more susceptible of this kind of action than most elastic membranes. This may be proved by covering a horizontal portion of any of these substances with sand, and sounding the pipe of an organ at the distance of a foot or so. The sand will be violently agitated, and will form figures composed of numerous curved and bending lines interlaced with one another.

In the second part of this able memoir, M. Savart applies these experiments to the illustration of the uses of the membrane of the tympanum, and of those of the external ear, both of which, as he shows by direct experiments on the ears of animals, are susceptible of being thrown into a state of vibration, by bodies vibrating at a distance. As our limits will not permit us to follow our author through his numerous and interesting details, we shall conclude this abstract with an enumeration of the leading results which he has obtained.

1. That it is not necessary to suppose, as has hitherto been done, the existence of a particular mechanism, for continually bringing the tympanum to vibrate in unison with the bodies which act upon it. It is evident, that the tympanum is always in a condition to be influenced by any number of vibrations.

2. That its tension does not probably vary, unless to aug-

ment or diminish the amplitude of its excursions, as Bichat had supposed. He supposed, however contrary to the result of experiment, that the tympanum unstretched itself for strong impressions, and stretched itself to receive weak impressions.

3. That the vibrations of that membrane communicate themselves, without any alteration to the labyrinth, by means of the small bones, in the same manner as the vibrations of the upper table of an instrument are communicated to the lower table.

4. That the small bones modify also the excursions of the vibrating parts of the organs contained in the labyrinth.

5. That the cavity of the tympanum (*Caisse du Tambour*) serves probably to keep up near the apertures of the labyrinth, and the internal face of the membrane of the tympanum, an aërial medium, whose physical properties are constant.

ART. XXII.—*Analysis of Euchroite.* By EDWARD TURNER, M. D. F. R. S. E. &c. Lecturer on Chemistry, and Fellow of the Royal College of Physicians, Edinburgh.

A SMALL fragment of the new mineral species, Euchroite,* having been presented to me for analysis by Mr Haidinger, I proceeded to a chemical investigation of it in the following manner.

When heated in a clean glass tube *per se*, its water of crystallization was disengaged, and this occurred at a temperature far short of redness. If the heat is gradually applied, it suffers no decrepitation whatever, retaining its form completely; its brilliant colour, however, is afterwards found to have changed to a dull green, and it crumbles into powder under the gentlest pressure. It undergoes no farther change on glass, its point of perfect fusion being above that of difficultly fusible glass. Urged by the blow-pipe on a piece of clean platinum, without exposure to the reducing flame, it fuses completely, and crystallizes on cooling into a greenish brown mass. Heated before the blow-pipe on charcoal, it fuses readily, and at the same moment deflagrates; the odour of arsenic is then also perceptible, and white vapours rise. On continuing the blast, a distinct copper corn is left. If the reduction is performed in a glass tube, both a metallic crust of arsenic and minute crystals of arsenious acid condense on the cold parts of the glass, which are easily and completely driven off by heat.

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* See Mr Haidinger's Description of Euchroite, p. 133 of the preceding Number.

It dissolves readily in concentrated and diluted nitric acid without effervescence, or formation of nitrous acid fumes, even on the application of heat. The addition of water neither caused precipitation, nor disturbed the transparency of the solution. Ammonia occasioned a greenish blue precipitate, which was wholly redissolved by an excess of the alkali, forming the blue solution characteristic of the peroxide of copper. The nitrate of silver caused no precipitate, nor did the muriatic and sulphuric acids. The absence of iron was proved by the tests of ammonia, ferrocyanate of potash, infusion of galls, and sulpho-cyanic acid. Acetate of lead caused a white precipitate, soluble in an excess of nitric acid. A stream of sulphuretted hydrogen, the sulphuret of copper which first fell being separated, gave rise to the formation of orpiment.

It appears from these observations, that Euchroite contains nothing but arseniate of copper, and water of crystallization. To determine the amount of the latter, 3.905 grains were heated at the flame of a spirit-lamp, in a clean glass tube, till all the water was expelled. The loss amounted to 0.73 grains, or 18.69 per cent. In another experiment, 2.565 grains lost 0.485 of a grain or 18.9 per cent. Taking the mean of these experiments, Euchroite contains 18.8 per cent. of water of crystallization. The water, as it condensed in the cold parts of the tube, was carefully tested by delicate litmus-paper, which was not reddened in the least; and I am satisfied, that all the water can be separated, by heating cautiously, without the loss of any acid.

8.35 grains of the anhydrous mineral were dissolved in dilute nitric acid, and then a concentrated solution of pure potash, which had been prepared by means of alcohol, was added in such excess as to separate all the arsenic acid from the oxide of copper. After due ebullition and washing, the latter was collected on a filtre, ignited, and weighed. By this process, 4.925 grains of the peroxide of copper were obtained.

The alkaline solution was rendered acidulous by nitric acid, and then evaporated to dryness to obtain a perfectly neutral solution, and to separate a minute quantity of silica which had been dissolved by the potash. The arsenic acid was then precipitated by a neutral solution of the nitrate of lead. This operation was performed at a boiling temperature, and with as slight an excess of the precipitant as possible, to prevent the nitrate from combining with the insoluble arseniate of lead;—an inconvenience complained of by Berzelius in the case of phosphoric acid, and which I have repeatedly felt myself, when precipitating arsenic acid by the acetate of lead. A very pure arseniate of lead was thus procured; but on evaporating the clear solution by a gentle heat to dryness, and re-dissolving the soluble parts, an additional portion of the arseniate was obtained,—showing that all the salt had not fallen in the first instance. The arseniate of lead, after being heated to redness, weighed 9.955 grains, equal to 3.399 grains of arsenic acid, on the assumption that arseniate of lead contains 34.14 per cent. of acid.

The anhydrous Euchroite consists, therefore, of

Peroxide of Copper,	4.925	58.97
Arsenic acid,	3.399	40.7
	8.324	99.67

The crystallised mineral is composed of

Peroxide of Copper,	47.85
Arsenic acid,	33.02
Water,	18.8
	99.67

Did phosphoric acid exist in Euchroite, it would of course be present in the arseniate of lead. On decomposing a portion of that salt by sulphuric acid, and neutralizing the clear solution with potash, nitrate of silver was added. The brick-red arseniate of silver subsided without any admixture of the yellow phosphate. Another portion of the arseniate of lead was heated before the blow-pipe, on charcoal. Decomposition readily ensued, with evolution of copious arsenical vapours. Numerous globules of metallic lead were procured, but not the slightest trace of the characteristic phosphuret of lead could be detected. Phosphoric acid cannot, therefore, enter into the composition of Euchroite.

I shall only remark, with respect to the atomic constitution of Euchroite, that the proportion established by analysis is not satisfactory in theory. Supposing an atom of the peroxide of copper to be eighty, and an atom of arsenic acid sixty-two, (the estimate of Dr Thomson,) we shall require almost four per cent. more acid than is given by analysis, to establish a due proportion; and, even then, the water of crystallization would not agree. The proportions of Berzelius are still more discordant. But we are not warranted, I conceive, in assuming, on speculative grounds, so great an error in an analysis, unless it bear internal evidence of inaccuracy. The quantity operated on was, indeed, of necessity, small, and, therefore, the unavoidable errors of analysis would have considerable influence on the result; but as they were rendered trifling by careful manipulation, and the employment of an exceedingly delicate balance, the whole error could hardly amount to one per cent.

It is pleasing to see an analytical result square neatly with the doctrine of proportions; and when it does so happen, it is no small confirmation of the accuracy with which the analyst has operated. So general, indeed, are the laws of combination, that an analysis may sometimes be regarded as incorrect which does not correspond with theoretical considerations. Such an inference, however, is by no means admissible wherever arsenic acid is concerned; for our knowledge of its atomic constitution is far less precise than that of most other substances. To justify this observation, I need only mention, that the two celebrated analysts, Professors Thomson and Berzelius, who are deservedly held as our first authorities on this as on many subjects, have both abandoned the opinions they formerly maintained, and that the conclusions at which they have eventually arrived are strikingly discrepant.

The Euchroite not only differs in mineralogical characters from the other native arseniates, but is also distinct in chemical composition. The proportion of oxide to acid is very similar to that of Count Bournon's third species, as analysed by Mr Chenevix; * only this mineral appears to contain no water of crystallization. A new analysis of the Cornwall arseniates is at present a desideratum; for, notwithstanding the known accuracy of Mr Chenevix, that chemist seems to have disregarded the probable existence of phosphoric acid in some of his arseniates. As I expect soon to possess, through the kindness of Mr Allan and Mr Haidinger, a whole series of the Cornwall arseniates, I hope in no long time to enter on the investigation of them.

ART. XXIII.—*Description of Fraunhofer's Large Achromatic Telescopes.* With a Plate.

THE great discovery of a method of making flint glass in large pieces, and perfectly pure and free from striæ, which was made by the late M. Guinand, and of which we have given a full account in this number, (see p. 348,) may be considered as forming an era in the history of the achromatic telescope.

By means of this glass, M. Fraunhofer, the director of the Optical Institute or Manufactory at Benedictbauern, near Munich, has constructed achromatic telescopes far superior to any that have hitherto been made; and we can assure our readers, of what many of them will deem incredible, that this eminent artist can now make achromatic object glasses with an aperture of *eighteen inches*. But it is not merely in the optical part of the instrument that M. Fraunhofer has been successful. His various improvements on the apparatus which accompanies the telescope, and his ingenious micrometers for measuring angles of all kinds in the heavens, have received the

* *Phil. Trans.* 1801, p. 199.

sanction of some of the most eminent practical astronomers in Europe, and are now considered as constituting an instrument of incalculable value for general astronomical observations.

The splendid telescope, which we have already mentioned (see p. 174) as made for the observatory of Dorpat, is shown in Plate VII., where the instrument is represented as mounted parallactically upon a stand, the telescope being balanced in every position. The hour circle is divided by two verniers into *four* seconds of time, and the declination circle into *ten* seconds. The equatorial axis is put in motion by a clock having two sets of wheel-work, so that the telescope follows by itself the diurnal motion of the stars. But it may also be turned freely by the hand in every direction, or by means of an endless screw. The friction of the equatorial axis is diminished by friction rollers, so that the telescope, though its weight was about thirty-six quintals of Bavaria, could be moved by the pressure of a single finger.

The figure in Plate VII. represents the telescope as seen from the side on which the clock is placed.

The object-glass is thirteen and one third feet (Pied de Ro de Paris) in focal length, and its aperture is nine inches.

It has eight astronomical eye-pieces, beside the following micrometers.

1. A repeating line micrometer, with a circle of position, whose two verniers give a single minute. This micrometer is furnished with a mechanism for illuminating the lines, the field remaining obscure, so that these lines appear to be luminous stripes on a dark ground. These lines are, as we are informed, cut upon glass with a diamond point. As these lines appear like so many silver threads suspended in the heavens, the transits of the smallest stars across them may be observed.

2. Two micrometers, each of which consists of two free rings.

3. Two micrometers with one free ring. In all these micrometers, the rings, which are accurately turned out of brass, are fixed upon plates of glass, so that they seem to be suspended in the field of the telescope. By observing the immersions and emersions of the stars at the inner and outer circumferences of the rings, the differences of right ascension and declination of two stars are determined.

4. A micrometer of several concentric rings, which may be illuminated in the dark field. This micrometer has *four* eye-glasses.

5. An achromatic finder, of thirty inches in focal length, and twenty-nine of aperture.

6. An instrument for correcting the axis of the great object-glass.

The price of the telescope now described is about 8000 Prussian dollars, or nearly L. 1300 Sterling. The total weight of the whole package was thirty-eight quintals.

An achromatic telescope, with an object-glass *eighteen* feet in focal length, and with an aperture of *twelve* inches, and furnished with eye-glasses, micrometers, and parallactic stand, like the one now described, amounts to about L. 2720 Sterling.

Mr Fraunhofer engages likewise to construct these instruments with object-glass *eighteen* inches in diameter; and, as the price increases nearly as the cube of the diameter, an instrument of this kind will cost about L. 9200 Sterling.

ART. XXIV.—*On the Neptunian Formation of Siliceous Stalactites.*[*] By the Rev. JOHN FLEMING, D. D. F. R. S. E. Communicated by the Author.

THE formation of siliceous minerals has perplexed, in no ordinary degree, the different sects of Geologists. The Vulcanists and Volcanists have, in vain, attempted to repel the objection brought against their views, founded on the refractory nature of silica in the fire, amounting to *infusibility.* The Neptunians have been equally embarrassed with its character of *insolubility* in aqueous menstrua. Fluxes have been resorted to by the former, and solvents by the latter, without any thing satisfactory to the unprejudiced having been announced. It is not to be concealed, however, that several facts in the natural history of siliceous minerals, which have been established, lead to the conclusion that solvents of silica do exist in nature, though these solvents be yet unknown to the chemist, and only appear in the results which have taken place.

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[*] Read before the Royal Society of Edinburgh, March 7, 1825.

The occurrence of *flint*, in concretions arranged parallel to the seams of stratification in *chalk*, and the analogous position of *menilite* in adhesive slate in gypsum, intimate the existence of a condition in which siliceous and calcareous matters have been influenced by similar circumstances. In reference to the chalk-beds, it may be supposed that the substances were deposited in the state of *mud*, which has been since changed into flint and chalk. That such a process of lapidification has been going on in the bed, is demonstrated by the occurrence of *shells*, originally of an imbricated structure and compact fracture, now exhibiting the granular structure, or foliated fracture of marble or calcareous spar; yet retaining distinct traces of the albuminous animal matter. The fusion of the siliceous mud by heat, and its consequent conversion into flint, as has been conjectured to have taken place, by Mr Allan in his valuable paper "On the Formation of the Chalk Strata, and Structure of the Belemnite," Edin. Phil. Trans. ix. 416, is a view of the matter, the incorrectness of which is demonstrated by the appearances exhibited. How is it possible to conceive the application of any heat capable of fusing the flint distributed in layers throughout the bed, which would not fuse, at the same time, the far more fusible surrounding chalk? Yet the chalk in immediate contact with the flint is earthy, and does not exhibit any one of those appearances to be looked for in fused carbonate of lime. It is equally impossible to conceive the cavity of an *echinus* filled with flint in fusion, while its thin calcareous, and consequently fusible crust, shall be capable of retaining all the delicate arrangement of its parts, preserving unobliterated, the sutures, the tubercles, and the minute bronchial pores. Mr Allan seems to have been aware of all these objections, but he has been unfortunate in his attempt to obviate them. "But we have," he remarks, "many such *anomalies* in nature; the base of many of the trap rocks presents as little the appearance of crystallization as even the softest chalk, and yet it is now admitted, even by the pupils of the Freyberg School, to be of igneous origin," p. 417. I was not a little amused, by thus witnessing Mr

Allan, in his distress, seeking shelter under the mantle of Werner! He will find it in this case, however, but a cobweb. Let us suppose, with Mr Allan, that the pupils of the Freyberg school can view these anomalies in trap rocks, and, in spite of such testimony to the contrary, continue to believe in their igneous origin, it remains to be asked, what explanation of these anomalies can be given to one, who is not a pupil of the Freyberg school, and who does not admit the igneous formation of trap rocks? Can it be any thing but a confession, *that the hypothesis is opposed by the phenomena?*

Flinty matter sometimes occurs in older limestones than the chalk, in such situations as to offer equally formidable objections to the igneous geologists. The specimens now exhibited to the Society seem to be of this description. They were found, many years ago, in a quarry on the estate of Kirkton, near Bathgate, West Lothian. This quarry was opened in a bed of limestone, which dips under the great bed of limestone belonging to the coal-field which extends north towards Linlithgow. This great bed is regularly stratified, and dips to the west at an angle of about 20°. It encloses the remains of those marine animals which are common in the limestones of the coal formation, with the beds of which, on both sides, this mass is conformable. Flinty matter occurs in this bed, disseminated in irregular thin layers, or in shapeless masses, occasionally containing relics of marine animals.

The bed of limestone to which we more particularly refer exhibited in some places the ordinary massive or compact structure, but in others it displayed that subconcentric lamellar concretionary arrangement so characteristic of calcedony. The different layers of these undulating plates presented many varieties of the botryoidal and mammillary forms. But the layers did not consist exclusively of carbonate of lime. Plates of flint likewise occurred, alternating with the limestone in parallel layers. The siliceous matter likewise abounds in the layers of limestone. When a mass of this substance is exposed to the weather, the calcareous matter wastes, and the flinty portion appears in high relief. Maceration in acid, as has taken place in one specimen, likewise exhibits its true structure. In the cavities produced by the irregular contortion of these strata, crystals of quartz, calcareous spar, and magnetic iron ore, occur.

Vegetable remains occur in this bed. Several trunks of trees, with their branches, could be distinctly traced, enclosed by the flinty and calcareous matter, as in the specimens exhibited. In some cases the woody matter was removed, and petrifaction had taken place so completely, as to leave only the traces of the original in the fibrous structure of the cast. In other cases the texture of the wood seemed to be but little altered, as the concentric zones were visible, the perpendicular fibres separable, and even sectile. These remains were sometimes of a brown colour, crossed with veins of calcareous spar. In the petrified matter, both flint and limestone abounded. The casts, except in one instance, presented no marks by which the species or genus could be determined. This example seems to be identical with the *Phytolithus Plantites verrucosus* of Martin, "*Petrificata Derbiensia*," Tab. XI. fig. 1, and which I have found to be a common production of the sandstone, clay-ironstone, and vegetable limestone of the Lothian coal-field.

The same objections present themselves against the igneous origin of the flint in this case, as in the chalk-rocks. I may add, that I have observed calcedony in a similar position to the flint in the present specimens, in the compact limestone at Inverugie, near Duffus, Morayshire. Are we, therefore, to consider that this peculiar botryoidal structure in limestone is produced by the *influence* of siliceous matter with the tendencies of calcedony? We should feel inclined to adopt this opinion, were we not aware of a similar structure prevailing in limestone, destitute of any notable quantity of siliceous matter, as at Inchkeith.

In the cavities of the chambered univalve shells, which occur in a petrified state in our limestone rocks, no *earthy* substances are observed, unless in the pipe which opens externally, or in those chambers which have broken walls. In those which are closed on all sides, crystalline minerals are observed to have exclusive possession, and these are usually calcareous spar and quartz, or rock crystal. That the former, in solution, percolated the walls of the chamber, and crystallised in the cavity, will readily be allowed, since the Neptunian character of calcareous spar cannot be disputed; but what prevents us from drawing the inference that the rock-crystal reached its station under similar circumstances?

Silicified wood occurs in alluvial soil, in such circumstances as to warrant the conclusion, that the petrifying matter was brought into its present situation by the agency of water.

But the proof that siliceous matter is soluble in aqueous menstrua is presented to us in the most unequivocal manner by gramineous vegetables. In the epidermis of these plants, the silica is arranged in a symmetrical manner. It seems obviously to be a natural secretion of the plant in the construction of its ordinary integuments. Sometimes it occurs as a morbid secretion in the joints forming the well known tabasheer.

The preceding facts leave no room to doubt that silica is found in nature in the state in which it appears to have been deposited from a solution; and the following observations seem to countenance the conclusion.

In this neighbourhood, the prevailing rocks belong to the trap family, and consist principally of amygdaloid, clinkstone, greenstone, and compact felspar, as subordinate to the old red sandstone. Where quarries are opened in these rocks, the rents near the surface are numerous, and form small cavities, the walls of which are occasionally covered with calcareous and siliceous stalactites, though always in thin crusts. In some cases, the liquor from which these have been produced seems to have been small in quantity, to have been collected in one spot on the roof, and to have left a thin film of the earthy matter not larger than the nail of the finger. In other cases, the surface covered is of greater extent, but the thickness of the matter never reaches a quarter of an inch. The siliceous matter seems to have dropped from the roof of the cavity, in some instances, on the fragments of rock, on the floor, forming stalagmites.

The surface of this stalactitic crust is rough, and, where thickest, it rises into numerous blunt mammillary processes. In the siliceous portions, these processes acquire a degree of hardness, translucency, and smoothness of surface, approaching to calcedony. When they are steeped in an acid, they part with the calcareous matter, and the macerated remnant intimates by its appearance that the two substances occurred in alternate layers; the calcedony, however, prevailing towards the surface.

The specimens now exhibited will serve to give a correct idea of the nature of this incrustation, and furnish evidence of its recent origin, *since it invests even the loose fragments of the rock.* We know the Neptunian origin of calcareous stalactites; and here they occur alternating with those in which silica predominates. Need we hesitate, then, to conclude that the calcareous and siliceous ingredients were suspended in the same menstruum, and deposited under similar circumstances? We may conjecture that the water was aided by heat, by alkalies, or by carbonic acid or carburetted hydrogen, rendered powerful by compression; but these are mere mental efforts to avoid a conclusion which the circumstances of the case justify, but which militates against our theoretical prejudices.

MANSE OF FLISK, *22d February* 1825.

ART. XXV.—*Notice of the* Rev. W. WHEWELL's *General Method of calculating the Angles made by any Planes of Crystals, and the Laws according to which they are formed.*[*]

THE object of Mr Whewell's inquiry was to obtain a new system of notation for expressing the planes of a crystal, and their laws of decrement, and to reduce the mathematical part of crystallography to a few simple formulæ of universal application. The author proposes to represent each plane of a crystal by a symbol indicative of the laws from which it results, which, by varying only its indices, may be made to re-

[*] This Notice is composed of an abstract of Mr Whewell's paper, as read before the Royal Society on the 25th November 1824, and published in the Journal of Science, No. XXXVI. and of a short notice of the Formulæ themselves, which Mr Whewell was so good as to send us at our request.—ED.

present any law, and by means of which, and of the primary angles of the substance, a general formula may be derived, expressing the dihedral angle between any one plane resulting from crystalline laws, and any other. The angle contained between any two edges of the derived crystals, may also be found in the same manner; and conversely, having given the plane, or dihedral angles of any crystal, and its primary form, the laws of decrement according to which it is constituted may be deduced by a direct and general process.

The mathematical part of this paper depends on two formulæ, by one of which the dihedral angle included between any two planes can be calculated, when the equations of both planes are given; and by the other, the plane angle included between any two given right lines can, in like manner, be expressed by assigned functions of the co-efficient of the equation supposed given. These formulæ being taken for granted, it remains to express, by algebraical equations, the planes which result from any assigned laws of decrement for the different primitive forms. For this purpose, the author assumes one of the angles of the primitive form supposed in the first case a rhomboid, as the origin of three co-ordinates respectively, parallel to its edges, and supposes any secondary face to arise from a decrement on this angle, by the subtraction of any number of molecules on each of its three edges. It is demonstrated, first, that the equation of the plane arising from this decrement will be such, that the co-efficients of the three co-ordinates in it (when reduced to its simplest form) will be the reciprocals of the numbers of molecules subtracted on the edges to which they correspond.

If the constant part of this equation be zero, the faces will pass through the origin of the co-ordinates; if not, a face parallel to it may be conceived passing through such origin, and will have the same angles of incidence, &c. on all the other faces of the crystal,—so that all our reasonings may be confined to planes passing through the origin of the co-ordinates.

In order to represent any face, Mr Whewell encloses between parentheses the reciprocal co-efficients of the three co-ordinates of its equations, with semicolons between them.

He then shews how truncations on the edges and angles of the primitive form are represented in this notation, by one or more of the elements of which the symbol consists becoming zero, or negative, thus comprehending all cases which can occur in one uniform analysis.

The law of symmetry in crystallography, requires that similar angles and edges of the primitive form should be modified similarly, to produce a perfect secondary crystal. This gives rise to *co-existent planes*.

In the rhomboid, three co-existent planes are formed by simple permutation of the elements of the symbol, one among another. In the prism, such only must be permitted as relate to similar edges.

In other primitive forms, such as the tetraëdron, Mr Whewell institutes a particular inquiry into the decrements of the co-existent planes which truncate the different angles of the primitive form, as referred to that particular angle which he assumes as the origin of the co-ordinates. In this latter case it follows, from the analysis, that each of the elements of the symbol must be combined with its excess over each of the remaining two, to form a new symbol. This gives four symbols, each susceptible of six permutations, making in all twenty-four faces.

Mr Whewell then considers a variety of other cases, and treats of the order in which the faces lie in a perfect crystal, and the determination of such faces as are adjacent, or otherwise. Lastly, he investigates the angles made by edges of the secondary form.

The following formulæ may be used for calculating the angles made by any secondary faces of a crystal, when the law of its derivation from the primary is known; and conversely, for determining the law of formation when the angles of the secondary form are given.

Let any solid angle, contained by three plane angles of the primary form, be considered as the origin of our measurement; let x, y, z be the three edges, formed by the meeting of the three planes. Let any secondary plane, cut off from x, y, z, lines of which the *reciprocals* are p, q, r, respectively.

This plane may be represented by $(p\,;q\,;r)$. And another plane for which the corresponding quantities are p^1, q^1, r^1, will be represented by $(p^1\,;q^1\,;r^1)$. Let the dihedral angles at the lines, x, y, z, respectively, be α, β, γ; and let θ be the angle contained by the planes $(p\,;q\,;r)$ and $(p^1\,;q^1\,;r^1)$, then we shall have, in all cases,

$$-\cos\theta=\frac{pp^1+qq^1+rr^1-(pq^1+p^1q)\cos\gamma-(pr^1+p^1r)\cos\beta-(qr^1+q^1r)\cos\alpha}{\sqrt{\{(p^2+q^2+r^2-2pq\cos\gamma-2pr\cos\beta-2qr\cos\alpha)\,(p'^2+\text{\&c.})\}}}$$

The second factor of the denominator differing from the first, in having p^1, q^1, r^1 instead of p, q, r.

Thus, if the primary form be a rhomb, we shall have $\gamma=\beta=\alpha$: and if planes be derived from the same law operating upon different edges of the rhomb, the planes will be $(p;\,q;\,r)$, $(p\,;r;\,q)$, $(q\,;\,r\,;\,p)$, &c. the result will be a bipyramidal dodecahedron, and the alternate dihedral angles θ, θ^1, at the edges of the pyramids, will be given by the formulæ

$$-\cos\theta=\frac{p^2+2qr-(q^2+r^2+2pq+2pr)\cos\alpha}{p^2+q^2+r^2-2(pq+pr+qr)\cos\alpha};$$

$$-\cos\theta^1=\frac{2pq+r^2-(p^2+q^2+2pr+2qr)\cos\alpha}{p^2+q^2+r^2-2(pq+pr+qr)\cos\alpha}.$$

If the secondary plane, instead of being derived by truncating the angle which is the origin, be parallel to the truncation of some *other* solid primary form, some of the quantities p, q, r will be negative, and the formulæ will still be applicable.

If the secondary plane be parallel to the truncation of an *edge* of the primary, as, for instance, the edge x, the corresponding index p will be 0. Thus, $(0\,;\,q\,;\,r)$ represents a plane replacing one of the superior edges of the rhomb; and $(0\,;q\,;-r)$ represents a plane replacing one of the lateral edges.

The same formula is equally applicable to the other primary forms besides the rhomb; and the reference of the secondary planes of these forms to one of the angles as the origin, is capable of being rendered very simple.

ART. XXVI.—*On the Methods of Preventing the Accidental Discharge of Fire-Arms*, Invented by the Rev. J. SOMERVILLE, Minister of Currie. Communicated by the Author.

THE *principle* of these methods of preventing accidental discharge consists in calling in the aid of the *left hand;* so that, while the ordinary gun in common use can be fired off solely by the action of the right hand, Mr Somerville's gun requires *both;* the left hand to undo the stop, slide, or catch, by which the gun is locked, and the other to draw the trigger, the same as in an ordinary gun; the left hand being equally necessary to work the gun in the field as the right.

The principle now described may be varied to a great extent; but the inventor confines himself at present to the description of the two following methods.

The first method, shown in Plate IV. Fig. 7, prevents accidental discharge by means of a stop, slide, or catch, situate on the surface of the trigger plate, and either lying on or bedded into it, as the gunmaker or sportsman pleases. It is pressed forward into a nick in the trigger by a spring situate behind them, under the strap of the guard, and thereby prevents the trigger from acting, or pressing by any accident on the seer of the lock, by which the gun would be discharged. On the fore part of the guard, where the left hand presses, is a moveable part, called a key, which may be removed at pleasure, and operates upon the stop in the act of discharging the gun. When this key is removed, the gun cannot be used until it is replaced.

If the sportsman fires with the left hand forward on the stock of the gun, instead of being on the guard, then the key can be placed forward to any part of the fore-stock; and in that case, the end of the stop towards the left hand must run forward to that part of the stock, and there receive the key. This key, which may also be of any form or size, is also removeable at pleasure.

The second method (see Plate IV. Fig. 8.) prevents accidental discharge by means of a peg screwed into the end of the main-spring, next the swivel, or into the swivel itself. The peg may be also solid, that is, a part of the swivel itself, the end of the swivel being lengthened, and shaped into the form of a peg. This peg, when the gun is fired, passes down through a hole or opening towards the trigger-plate of the gun. The gun is prevented from being discharged by means of a slide, opening and shutting the hole at pleasure, through which the peg descends when the gun is fired. This slide is pressed forward into the hole or opening through which the peg passes in a similar way to the one just now mentioned in the foregoing method. When the gun is fired, the left hand, by a gentle pressure, throws back the slide, and thus lays open the hole in the stock and trigger-plate, and allows the peg to pass downward, and, of course, the main-spring to traverse its full distance. Keys are fixed upon, and removeable at pleasure, from this gun, the same as in the former method just described.

The first advantage which this gun possesses over the ordinary gun is the complete security which it affords against accidental discharge, and the consequent preservation of human life. This is the grand object of the present contrivance. Its other advantages are all subordinate to this.

It is not without reason that writers have cautioned sportsmen about the danger of fire-arms, and that the anxiety of parents has been awakened by the risk their sons run in the use of them. The waste of human life by the accidental discharge of fire-arms is truly deplorable. Not only every season, but almost every week of every season, brings us accounts of the most valuable lives being lost in this way. The inventor, within the space of little more than a year, the time when he first began to notice such accidents, has marked, within the narrow limits of his own observation, no less than sixteen or eighteen lives lost by the accidental discharge of fowling-pieces. The death of a fine youth of eighteen, the eldest son of his family, and belonging to his own parish, occasioned in this way, and accompanied with the most tragical circumstances, first led the inventor to think of this subject; and since that time he has been in the habit of marking similar occurrences. He may state it as a fact, that, at an average, there is not less than from twenty to thirty lives, throughout Great Britain and

Ireland, lost every year in this way, besides far more than that number maimed and wounded. Against such fatalities the gun now described presents the most *absolute* security. Accidental discharge with it is completely out of the question; at least, the probability of it is so small, as to be beyond the reach of calculation. If accidental pressure shall touch the triggers, no evil happens, because they are locked; if it touches the key, no evil happens, because the pressure, by that time, is supposed to be removed from the triggers. The pressure must be against the triggers and on the key at the same instant of time, otherwise the locks will not work. If the triggers are touched the twinkling of an eye before the key, or the key before the triggers, then no evil can ensue; for, unless touched at the same instant of time, they mutually support and counteract one another, and thus prevent the gun from going off. Accident may touch the key and the triggers of this gun, as well as any other; but then accident cannot touch both key and triggers at the same instant of time. Design only can touch *two* specific points at *one* specific time. If accident does touch the key and triggers of this gun, it must be in succession; but successive touching will not fire the gun. It must be simultaneous to do it; but this supposes thought, and thought supposes design. The inspection of the gun or the figure will make this more palpable than any words can; and to them we refer to confirm what has been said.

The second advantage which this gun possesses over the ordinary fowling-piece is superior dispatch, as it allows the sportsman always to go with the *utmost* security, with his gun full cocked, and, of course, saves the time of cocking the gun when game rises unexpectedly. So sensible are sportsmen of the advantage of having their fowling-pieces always full cocked, that the writer knows some of them who always go with their guns so prepared, though at the risk both of their own and the lives of their friends. The present invention, however, renders this practice not only harmless, but adviseable and advantageous, as it thus unites the greatest dispatch with the most perfect security.

The third advantage which this gun enjoys over others is the ease and tranquillity of mind, which it necessarily imparts, not only to the sportsman himself, but to his friends, parents, relations, and guardians at home. No man of ordinary feeling can be perfectly at ease, surrounded by his friends, with a loaded gun in his hand, leaping walls, crossing ditches, brushing through thickets, underwood, and hedges, when, all the while, the life of his friends is within the reach of a mortal weapon, and the danger of that weapon guarded against only by the fallaciousness of memory; and the risk increased tenfold by the eagerness of pursuit, and the suspension of thought necessarily occasioned by a species of amusement, which, more than any other, lays caution asleep, and occasions that flutter and hurry of spirits, from which such fatal accidents generally spring. Many a melancholy fact attests the truth of this remark. Even the most cautious man living, in the eagerness of pursuit, and the hurry of the moment, is sometimes off his guard; and, with the young and inexperienced sportsman, this is the case to an extent, which those accustomed to such pursuits only can know. Now, this gun will tend most effectually to allay all anxiety arising from such causes, and thus put the sportsman in the most favourable state, both for enjoying his amusement, and doing execution; as coolness and ease of mind are essentially necessary to do so with success.

The fourth advantage which this gun possesses over the ordinary gun is the safety which one of the modes of it gives to the left hand, in case the gun should burst. All good writers on the subject of shooting strongly recommend the sportsman to press the gun to his shoulder with the left hand close upon the forepart of the bow of the guard. Notwithstanding, this caution and advice are frequently neglected, and the laceration or loss of many a left hand, by the bursting of the barrel, has taught the sportsman the folly of doing so. With the ordinary gun, indeed, a man *may* fire with his left hand close to the guard, and thus preserve it: with one of the modes, on which this is constructed, he *must* do so, for there the safety-spring is placed, and until it is touched, the locks are immoveable.

Both on this point, and on the danger connected with the use of the ordinary gun, the writer begs leave to quote an authority, which will not be disputed.

Daniel, in his valuable work on Rural Sports, has the following observations on these subjects: "In shooting with a stranger," says he, "who perhaps keeps his gun cocked, and the muzzle usually pointed to the left, plead for the *right-hand* station, and that you cannot hit a bird flying to the left; with a game-keeper take the right hand without ceremony. In getting over a fence, constantly endeavour to go last, notwithstanding the usual assurance of, *My dear Sir, I am always remarkably careful:* and if a person beats bushes with a cocked gun, get out of his company, *as a shooter*, with all possible expedition.

"Always," continues he, "hold the gun with the *left hand close* to the *guard*, (and *not forward* upon the barrel, to strongly grasp it near the entrance of the ramrod, notwithstanding it has been so strenuously recommended;) all the requisite steadiness in taking aim, and even of motion, in traversing the flight of a bird, can be obtained by thus holding the heaviest pieces; and in case of a barrel's *bursting*, the *certainty* of having a hand or arm shattered, by *grasping the barrel*, is reduced to a *chance* of escaping the effects of such an accident, by placing the hand *close to the guard* beneath it."

The fifth advantage which the writer now states is, that he thinks a steadier aim can be taken by his mode of holding the gun, than in the ordinary way. He is convinced that one great cause of bad shooting is occasioned by grasping the gun too firmly with the right hand, or giving the right hand too much to do in the act of firing. The more easy the right hand holds the gun, and the less it has to do, with the greater precision it will act upon the triggers at the proper time. The right hand, therefore, should hold the gun very loosely, and have only one thing to do, namely, to pull the trigger, when the gun comes into the proper position to be discharged. Now, the gun we are here considering admits of this to the fullest extent. With it the left hand should do as it were the whole work, except pulling the trigger. The safety-spring being worked solely by the left hand, it should press the gun firmly to the shoulder, by which the safety-spring will be unlocked, and thus leave the right hand at perfect freedom, and with nothing to do, but merely to touch the trigger, when the gun comes into the proper position to be fired. Thus, by giving the left hand more to do, than in the ordinary gun, and therefore proportionally easing the right hand, the writer thinks, the gun will be held more steadily to the shoulder, a surer aim be taken, and greater execution done, than with the gun in common use, and in the ordinary mode of firing.

Lastly, a loaded gun may be rendered perfectly safe, when lying in a house, or entrusted to servants, or in the hands of ignorant persons, by merely taking off the key; for then the machinery that works the locks cannot be reached, and consequently the gun cannot be discharged.*

Manse of Currie, 28th Feb. 1825.

ART. XXVII.—*On Leslie's Photometer, and its application to determine the relative Intensity of the Sun's Rays, and the Illuminating Powers of Coal and Oil Gas.* By WILLIAM RITCHIE, A. M. Rector of the Academy at Tain. Communicated by the Author.

THE differential photometer of Professor Leslie has lately excited so much discussion, and has been so much the subject of conversation, that a fair and impartial account of its merits and defects cannot fail to be acceptable to the generality of readers. Those who defend the accuracy of the instrument are so lavish in its praise, that we may fairly conclude they have neither carefully examined the principles on which it is founded, nor the inaccuracies to which it is evidently liable. Those, on the contrary, who espouse the opposite side of the question, are so liberal in their condemnation of it, that we are led to suspect they have exaggerated its defects. At such a distance from the scene of action, I cannot be suspected of partiality to either party, and shall, therefore, calmly express my conviction of the truth, without the least apprehension of giving offence to Mr Leslie, whose love of philosophic truth is so ardent, that I am convinced he will be the first to acknowledge the justice of the following observations, or to point out the errors into which I may have fallen.

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* All guns, new and old, single and double, flint and percussion, are, at a small expence, susceptible of this improvement; and various specimens of them, so fitted up, may be seen at Mr William Maclachlan's, gun-maker, No. 39, Nicholson's Street, and at Mr John Thomson's, gun-maker, No. 3, South St Andrew's Street, Edinburgh, agents for the inventor. For England any farther information will be given on this subject, by Mr Robert Wheeler, gun-manufacturer, Birmingham, who has made arrangements with the patentee, both for fitting up guns on this principle, as well as supplying the trade in England.

The photometer is merely a differential thermometer, having one of its balls blown of black enamel, while the other is blown as thin and transparent as possible. The whole is then inclosed in a transparent glass case. The black ball intercepts the greater portion of incident light, whilst the transparent one allows the greatest part to pass freely through. The light which is thus intercepted by the black ball, is gradually conducted to the interior, and thus expands the contained air. As the black ball is placed considerably above the transparent one, (in the portable photometer,) the ambient air will continue to receive fresh accessions of heat, till the expenditure from the exterior surface of the glass is equal to the increment of light which the black ball intercepts. Now, as this quantity is partly carried off by radiation, and by the conducting and carrying powers of the air, it must vary with the surrounding sky, and with the density of the atmosphere, &c. A cold sweeping wind has also a powerful effect in carrying off the accumulated store of heat. These causes are so variable, that though the sun were to shine constantly with the same splendour, and remain in the same situation, the indications of the photometer would be extremely various. To be convinced of this, place the photometer opposite the sun, in a calm sheltered situation, and then remove it quickly to an elevated place, where it is exposed to a chilly wind from the north, and the number of degrees will be found to be less than formerly, even though the sun continued to shine with unclouded aspect. But, the instrument, when applied to measure the intensity of the sun's rays, is subject to another inaccuracy, which must have considerable influence in changing the result. The reflected light from the clouds and from the earth, mingles its effect with the direct radiation from the sun, so that we can deduce no conclusion whatever from the indications of the instrument under so many obstructing causes. Mr Leslie, with his usual ingenuity, has endeavoured to remove some of these disturbing causes, particularly the reflection of light from the surface of the earth; but, though this may be removed, the others remain in full force, and exert a powerful influence. Without making, therefore, a proper allowance for these obstructing causes, the indications of the photometer do not afford even an approximation to the relative intensity of the solar rays at different periods and in different situations.

It has lately been made a question, whether the photometer is acted upon by mere heat, unaccompanied with light. Both experiment and reasoning concur to prove, that mere heat can have no influence whatever upon it, unless that heat move with a velocity sufficient to permeate the glass case by which it is surrounded.* If the instrument be placed opposite a ball of iron heated almost to redness, no effect whatever will be produced; † but, if the temperature of the ball be raised so as to shine in the dark with a dusky red colour, the fluid in the stem of the black ball will sink a considerable number of degrees. If the temperature of the ball be raised still higher, it will produce a greater effect upon the instrument than the flame of the finest oil-gas, though the one possesses a much greater illuminating power than the other.

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* The opinion here expressed by Mr Ritchie, is in direct opposition to the experimental results of Delaroche and Berard, (recently confirmed by Dr Turner and Dr Christison,) which have been almost universally admitted by philosophers. The Rev. Baden Powell, F. R. S. has still more recently found, that the heat of luminous bodies, when intercepted by a pane of glass, is separated into two portions, one of which is absorbed by the screen, and the other transmitted, and that these two portions differ in their properties, the heat absorbed being always equally absorbable by black and white surfaces, while the heat transmitted is more easily absorbed by black than white surfaces.—Ed.

† Dr Turner and Dr Christison, have demonstrated by direct experiments, which we, and many others have seen, that Mr Leslie's photometer "is powerfully affected by *heat*," when placed "before a ball of iron heated, so as not to be luminous, or even before a vessel of boiling water." As Mr Ritchie has found the very reverse of this to be the case, we may conclude, that an instrument which, in such hands, gives such opposite results, cannot deserve much confidence.—Ed.

In the late discussions with regard to the relative values of coal and oil-gas, those who have employed Mr Leslie's photometer, seem to have overlooked the distinction between the terms *Quantity of Light* and *Illuminating Power*. By the former term, I would be understood to mean the number of atoms of light shooting out simultaneously from two luminous sources; by the latter, the power which these atoms possess of rendering external objects visible. The ratio of the former may be determined by a photometer founded on the expansion of air by its combination with light. The ratio of the latter cannot be determined by any method which does not employ the indications of the extremely delicate photoscope, the eye, as one of the elements in the calculation.

The method which Mr Leslie has proposed, evidently depends on the assumed principle, that the illuminating power is proportional to the quantity of light. This principle, from a very simple method, which I have lately employed for determining the illuminating powers of different flames, I find to be quite unfounded. When the colours of the flames are nearly the same, the illuminating powers will then be nearly proportional to the quantities of light; but when the colours are different, the illuminating power of the most brilliant light, increases in a much higher ratio than the mere quantity of light. Mr Leslie's method must, therefore, give results very unfavourable to the illuminating power of oil-gas, when compared with that of ordinary coal-gas.

But, as mere reasoning can never determine a question in physical science, unless that reasoning be founded on accurate experiment, I had recourse to the following experiment, which seems to put the matter beyond the possibility of doubt. I made a quantity of oil-gas of the very best quality, and an equal quantity of coal-gas, of an inferior quality, and not well purified. The one burned with a bluish flame, surrounded by a red fringe. The other threw out a torrent of white brilliant light. By Mr Leslie's method, the ratio turned out as *one* to *five*, though the one did not possess *one-twentieth part* of the illuminating power of the other. I have thus taken the qualities of the two gases very different, in order to shew more clearly the fallacy of the method in extreme cases, as it is more difficult to detect the error, which becomes small, when the coal-gas is of the best quality and highly purified. The method of Count Rumford, is equally false with that which I have now examined, particularly when the colours of the flames are different, as it will be found quite impossible to bring the shadows to the same density or even the same colour at any distance whatever. The celebrated question which has of late agitated not only the philosophical, but even the commercial world, has not yet received a solution sufficiently accurate to command the assent not only of the impartial observer, but even that of rival companies.

XXVIII.—*Notice respecting Trona, the native Carbonate of Soda from Fezzan.* By WILLIAM HAIDINGER, Esq. F. R. S. Edin. Communicated by the Author.

In order to establish the grounds upon which I believe the present notice not to be without interest to mineralogists, I shall previously give the description of Trona itself, and of the two species of hemiprismatic and prismatic Natron-salt, the two latter as contained in Professor Moh's *Treatise on Mineralogy*,[*] before entering upon those observations, which will naturally offer themselves in the course of comparing these species with each other.

1. *Trona.*

Hemiprismatic crystals observed similar to Plate VIII. Fig. 5, of which Fig. 6 is a projection upon a plane perpendicular to M and T.

Inclination of n on n = 132° 30′.
of M on T = 103° 15′.
of n on T = 103° 45′.

These angles were taken with the reflective goniometer, but particularly the last of them will perhaps allow of some corrections, if in future better crystals should be obtained. The angle a, b, c, at which, in the projection, Fig. 6, the edge between n and n is inclined towards the face T, was valued at about 62° by the assistance of the common goniometer. There is also a rough face, replacing the obtuse edge between *M* and *T*, the inclination of which, however, I could not ascertain.

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[*] *Translation*, vol. ii. p. 27 and 29.

Cleavage highly perfect, and easily obtained parallel to *M*; faint traces also parallel to *n* and *T*. Fracture uneven. Surface of *n* and *M* smooth, of *T* generally striated in a horizontal direction, or parallel to its edges of combination with *T*.

Lustre vitreous. Colour white, occasionally inclining to yellowish grey, when impure. Streak white. Transparent, perfectly so in minute crystals; the larger masses translucent. The index of ordinary refraction, measured through the faces *M* and *T*, is about 1.43; that of the extraordinary one measured in the same plane about 1.52; the two images are finely separated.

Rather brittle. Hardness = 2.5...2.75, very near that of alum, though a little superior to it. Sp. gr. = 2.112. Taste pungent, alkaline.

Compound Varieties.—Crystalline coats, consisting of numerous crystals fixed to the support in the place of the edges between *n* and *n*, and lengthened between *M* and *T*, generally thin, and nearly parallel, so as to produce a very distinct radiated fracture.

2. *Hemiprismatic Natron-salt.*

Hemiprismatic. $\mathrm{P} = \left\{ \begin{matrix} 79° \ 41' \\ 77° \ 14' \end{matrix} \right\}$, 154° 31′, 115° 22′. Inclination of the axis = 3° 0′, in the plane of the long diagonal. Fig. 7. Refl. Gon.

$$a : b : c : d = 19.10 : 34.72 : 13.67 : 1.$$

Simple forms. $\frac{\mathrm{P}}{2}\,(P) = 79°\ 41'$; $\frac{\breve{\mathrm{P}}\mathrm{r}}{2}\,(t) = 58°\ 52'$; $(\breve{\mathrm{P}}\mathrm{r}+\infty)^3\,(M) = 76°\ 28'$; $\mathring{\mathrm{P}}\mathrm{r}+\infty\ (r)$; $\bar{\mathrm{P}}\mathrm{r}+\infty\ (l)$.

Combinations. 1. $\frac{\mathrm{P}}{2} . (\mathring{\mathrm{P}}\mathrm{r}+\infty)^3 . \bar{\mathrm{P}}\mathrm{r}+\infty$. Fig. 8.

2. $\frac{\breve{\mathrm{P}}\mathrm{r}}{2} . \frac{\mathrm{P}}{2} . (\breve{\mathrm{P}}\mathrm{r}+\infty)^3 . \mathring{\mathrm{P}}\mathrm{r}+\infty . \bar{\mathrm{P}}\mathrm{r}+\infty$. Fig. 9.

Cleavage distinct, parallel to *t*, imperfect parallel to *l*, traces of *M*. Fracture conchoidal. Surface smooth and even.

Lustre vitreous. Colour white, when pure. Streak white. Semitransparent. (Even very small crystals possess lower degrees of transparency than crystals of Glauber-salt of the same size.)

Sectile. Hardness = 1.0 ... 1.5. Sp. gr. = 1.428. Taste pungent, alkaline.

Compound Varieties.—Several imitative shapes: composition columnar. Massive: composition granular. Individuals large, generally obtained by the assistance of art, as also the crystals themselves. It occurs in nature in a decomposed state, reduced to powder by the loss of its water.

3. *Prismatic Natron-salt.*

Prismatic. $P = 141^\circ 48', 52^\circ 9', 145^\circ 52'$ Fig. 10. Ap.
$a : b : c = 1 : \surd 0.806 : \surd 0.107.$

Simple forms. $P - \infty$; P (*P*); $(\breve{\mathrm{P}}\mathrm{r} + \infty)^3$ (*d*) $= 107^\circ 50'$; $\breve{\mathrm{P}}\mathrm{r} - 1 = 121^\circ 46'$; $\breve{\mathrm{P}}\mathrm{r}$ (*o*) $= 83^\circ 50'$; $\breve{\mathrm{P}}\mathrm{r} + \infty$ (*p*).

Combinations. 1. $\breve{\mathrm{P}}\mathrm{r} . (\breve{\mathrm{P}}\mathrm{r} + \infty)^3 . \breve{\mathrm{P}}\mathrm{r} + \infty .$ Fig. 11.
2. $\breve{\mathrm{P}}\mathrm{r} . \mathrm{P} . (\breve{\mathrm{P}}\mathrm{r} + \infty)^3 . \breve{\mathrm{P}}\mathrm{r} + \infty .$ Fig. 12.

Cleavage very imperfect; traces parallel to *p*; much interrupted by fracture, which is small conchoidal. Surface generally smooth. $P - \infty$ streaked parallel to its edges of combination with $\breve{\mathrm{P}}\mathrm{r}$.

Lustre vitreous, more bright upon *p*; the horizontal prisms being sometimes dull. Colour white; sometimes yellowish. Streak white. Transparent ... semitransparent.

Sectile. Hardness = 1.5. Sp. gr. = 1.562. Taste pungent, alkaline.

Observations.

As it has always been the custom in mineralogy to quote Pliny when treating of soda, it may be observed here, that the *Nitrum* of the ancients, generally allowed to be our soda, which was found in the vicinity of Naucratis and Memphis, in Egypt, may be Trona, because *lapidescit ibi in acervis: multique sunt tumuli ea de causa saxei*;[*] in the same way, as we find in the mineralogical works of the present day, that the natrum from the lakes in Egypt, is sufficiently hard and compact to allow walls to be constructed of it, as in a fort, near the Natrum Lakes, called *Qasrr* or *Cassr*, which is now abandoned.* But, as this is ascribed to an admixture of muriate of soda, and may be ascribed to a similar admixture in Pliny, it does not form an undoubted synonym of the species. Yet the coincidence of the accounts of this author, of houses being built of salt by the Hammanientes,† the Amantes of Solinus,‡ a nation carrying on trade with the Troglodytes, with the existence of a fort built of soda, is remarkable enough. Besides, Pliny comprises many substances under the name of nitrum, which are essentially different; Dr Kidd has already observed,§ that some of the Egyptian nitrum, which *calce aspersum reddit odorem vehementem*, must be sal ammoniac, and that often it means also our nitre. It appears that all the efflorescent salts were called nitrum, comprehending sulphate of soda, sulphate of magnesia, and others; nay, the passage in Pliny, *nam quercu cremata numquam multum factitatum est, et jampridem in totum omissum*, seems also to include potash, though this is likewise enumerated among the methods of obtaining salt, *quercus optima, ut quæ per se cinere syncero vim salis reddat.*

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[*] Plin. *Hist. Nat.* lib. xxxi. cap. x. vol. iii. p. 285. Elzev. 1635.

Among the modern authors, the earliest, and at the same time one of the most detailed accounts was given by Dr Donald Monro,‖ the first who pointed out, that the *pure native crystallised natron* occurred in some of the inland parts of Tripoli in Barbary. The salt is there stated to "run in thin veins, of about half an inch, or a little more, thick in a bed of sea-salt; for all of it that has hitherto been imported into this country, is covered with sea-salt on each side. The one side is always smoother than the other, and appears as if it had been the basis on which it rested; the other, which should seem to be the upper side, is rougher, by the shooting of the crystals. The pieces of the thin veins appear almost as if the salt had been dissolved in water, and afterwards boiled up into thin crystallized cakes, only that the crystals are much smaller, and in a manner that cannot be easily imitated by art; for when this salt is dissolved and evaporated to a pellicle, and left to crystallize, it always shoots into crystals resembling those of glauber-salt."

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* Klaproth's *Essays*, vol. ii. p. 62.

† Cap. xxx.

‡ Libr. v. cap. v. vol. i. p. 251.

§ *Outlines of Mineralogy*, vol. ii. p. 6.

‖ *Phil. Trans.* 1773, p. 567.

Another account was published by Mr Bragge,* Swedish consul at Tripoli; it is from his notice that more generally the indications in the works on mineralogy are taken. According to Mr Bragge, the "native country of this soda, there called Trona, is the province Sukena, two journeys distant from Fezzan. It is found at the foot of a rock mountain, upon the surface of the earth, at no greater depth than that of an inch, and as to breadth mostly that of the back of a knife's blade. It occurs always crystallized; on the fracture it exhibits concrete, oblong, parallel, and sometimes striated crystals; thus resembling crude or unburnt gypsum." † He states, moreover, that it is found twenty-eight days journey from the sea coast, where the salt mines are, and that it is not contaminated with common salt. Large quantities are exported to the country of the Negroes and to Egypt, besides 50 tons annually which are brought to Tripoli.

The description given by Klaproth himself is confined to the statement that he examined "crystalline incrustations, from one-third to half an inch thick, of accumulated parallel plates, standing on their smaller edges, and of a lamellar striated texture."

The systematic works on Mineralogy contain little farther information on this subject. Some have distinguished Trona as a particular sub-species, but the greater part include it in one species with the hemi-prismatic natron-salt, according to the principle that they both essentially consist of carbonate of soda.

From the treatises on geography we learn that there is a particular district of Fezzan, called Mendrah, with a hard and barren soil, but which has a commercial importance for the quantity of trona, a species of fossil alkali, which floats on the surface, and settles on the banks of numerous smoking lakes. Great quantities of it are brought by the merchants of Fezzan to be shipped at Tripoli. It is used in Morocco as an ingredient in the red dye of the leather, and in other manufactures. It forms part of the domains of the crown.[*]

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* *Vetensk. Acad. Handlingar*, 1773, p. 140.

† Klaproth's *Essays*, vol. ii. p. 63.

The difference between the chemical composition of the two substances, though evident in itself at the time when it was discovered, has only of late received a rule in the doctrine of fixed proportions, and becomes doubly interesting when compared in this point of view. The analysis of hemi-prismatic natron-salt, by Klaproth, gives

Soda, - - -	22.00
Carbonic acid, -	16.00
Water, - -	62.00

The formula by Berzelius, $\dot{\mathrm{N}}\mathrm{a}\,\ddot{\mathrm{C}}^{2}+20$ Aq., making use at the same time of his numbers, gives this proportion:

Soda, - -	21.77
Carbonic acid, -	15.33
Water, - -	62.90

The results of the analysis of Trona, by Klaproth, and of an analysis by Mariano de Rivero,[†] instituted with a native carbonate of soda, from the Lake of Merida, in Columbia, are the following:

	Fezzan.	Columbia.
Soda, - -	37.00	41.22
Carbonic acid, -	38.00	39.00
Water, - -	22.50	18.80

The 2.5 per cent. of sulphate of soda, in the analysis by Klaproth, not being considered as essential, the first of these results agrees very nearly with the formula, $\dot{\mathrm{N}}\mathrm{a}\,\ddot{\mathrm{C}}^{3}+4$ Aq., or,

Soda, - -	37.99
Carbonic acid, -	40.15
Water, - -	21.86

particularly, if we suppose that a small portion of the water was united to the sulphate of soda; while in the analysis by Mr Rivero, the proportion of soda is a little larger than the formula would require.

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[*] Playfair's *Geography*, vol. vi. p. 167. Horneman's *Travels in Africa*

[†] *Edin. Phil. Journ.* vol. xi. p. 215.

Klaproth observed, that it does not, like the common crystals, dissolve in its water, but that it retains its form, though it be exposed to a moderate red heat. It gives off the water with a crackling noise, if exposed in a glass tube to the spirit-lamp. It is much more difficultly soluble in water than the hemi-prismatic, or also the prismatic natron-salt; also its taste is less intensely alkaline. It does not like them give off its water of crystallization when exposed to the air; and it may be preserved for any length of time unchanged in an atmosphere, rendered perfectly dry by the contact of lime.

The chemical difference of the prismatic natron-salt and the hemi-prismatic species, if any, probably lies in the quantity of water which they contain, but it has not as yet been ascertained. They were first distinguished from each other as particular species in the first volume of the *Grundriss der Mineralogie*, by Professor Mohs, p. 526; the hemi-prismatic form of one of the species has also been recognised by Messrs Brooke and Levy. They may be both easily obtained from a solution of carbonate of soda. If this solution be perfectly saturated, and exposed to a farther evaporation, at a temperature of about 80°—100° Fahr., beautiful crystals of the prismatic species will be formed, whilst a less saturated solution will produce hemi-prismatic crystals at a lower temperature, or if cooled more rapidly. By recrystallizing under different circumstances, the crystals of the two species may be easily transformed into one another.

A solution of the supercarbonate of soda of the Edinburgh Pharmacopœia, exposed to a slow evaporation, yields small transparent crystals, possessing a hemiprismatic character. But they effloresce very readily, and though they seem to be different from those of any of the preceding species, I have not yet succeeded in obtaining them large enough for examination.

It is not a quite uncommon case, that mineral species which have once been described as such, or at least mentioned in works relating to the science, are subsequently neglected by those, whose care in constructing treatises on mineralogy should be to prevent information we are already in possession of, from perishing. Very frequently, indeed, they may be excused for having followed that course, when the description given was so indeterminate, that no remarkable points of difference from other species could be deduced from them, or when no description at all was given.

Trona has been very much in this situation. I have been indebted to Dr Hope for the specimens which have enabled me to ascertain some of its characters, and so far to supply the defects in the former descriptions, that it may in future be considered as a particular mineral species. The difference between the common carbonate of soda (the hemi-prismatic natron-salt of the method of Mohs) and the Trona of Fezzan, had already been pointed out by Klaproth; but it seems that even the chemical mineralogists have not paid that degree of attention to his correct determination which it deserves, because there was yet wanting the exact statement of those characters, which it possesses in its natural state, and upon which alone the determination of the species can be founded.

ART. XXIX.—*Description of Levyne, a New Mineral Species.* By DAVID BREWSTER, LL.D. F.R.S. Lond. and Sec. R.S. Edinburgh.

THE mineral of which I propose to give a brief description, was kindly transmitted to me for examination about a year ago, by Mr Heuland. In the memorandum which accompanied it, Mr Heuland stated that he suspected it to be new, and upon examining its optical properties, and comparing it with those minerals with which it seemed to be most closely allied, I had no doubt that it constituted a new and interesting species.

This mineral occurs in the cavities of an amygdaloidal rock, from Dalsnypen, in Faroe, and sometimes accompanies the Chabasie and Analcime, but particularly a new variety of the Heulandite.

Although this mineral is evidently a compound one from the distinctness of the re-entering angles, yet this composition is not seen when examined by polarised light, through the faces perpendicular to the axis. This circumstance would of itself have been sufficient to show that it has only one axis of double refraction, but I determined this to be the case, by the direct examination of the polarised rings. Its double refraction is negative, like that of calcareous spar, and other obtuse rhomboids, and though not great, yet the images may be easily separated. Its ordinary refraction is a little greater than that of almond oil, and very nearly the same as that of Primitive Chabasie.

I have sent a specimen, containing a few minute crystals of this substance, to M. Berzelius for analysis, but I have not yet received the results which he has obtained from them.

It is not soluble in acids, nor does it gelatinise with them. It whitens and intumesces with heat like Chabasie and Mesotype, and, according to Mr Haidinger's observations, it yields with salt of phosphorus a transparent globule, which contains a skeleton of silica, and becomes opaque on cooling.

For the following crystallographic observations I have been indebted to Mr Haidinger.

Rhombohedral. $R = 79^\circ\ 29'$.

$a = \sqrt{8.38}$.

Simple forms. $R - \infty\ (o)$; $R - 1\ (g) = 106^\circ\ 4'$; $R\ (P)$; $\frac{5}{4} R + 1\ (n) = 70^\circ\ 7'$.

Character of Combination. Rhombohedral.

Combination. $R - \infty$. $R - 1$. R. Fig. 4. of Plate VIII. represents two individuals composed parallel to $R - \infty$, the individuals being continued beyond the face of composition, as in Chabasie. Inclination of o on $g = 136^\circ\ 1'$, of o on $P = 117^\circ\ 24'$, of o on $n = 109^\circ\ 13'$.

Cleavage, indistinct, parallel to R. Fracture imperfect conchoidal. Surface, $R - 1$ and R streaked parallel to their common edges of intersection. $R - \infty$ uneven, and often curved, so that the opposite faces are often inclined on each other at an angle of $2^\circ - 3^\circ$.

Lustre vitreous. Colour white. Streak white. Semi-transparent.

Brittle. Hardness = 4.0.

I propose to distinguish this species by the name of *Levyne*, in compliment to Mr A. Levy, M. A. of the university of Paris, who is already well known to mineralogists, by his crystallographic acquirements, and by his determination of several new and interesting mineral species.

ART. XXX.—DECISIONS ON DISPUTED INVENTIONS AND DISCOVERIES.

In discharging the duties which the present series of papers has imposed upon us, we are glad to find that the principles we have laid down, as well as our method of applying them, have already obtained the sanction of those whose approbation will always be our highest reward.

As these pages can never be stained with personal allusions, nor the decisions which they bear influenced by any other feelings but those which truth inspires, we are not without the hopes, that the greater number of those whom we may place in the list of second inventors will acknowledge the justness of our sentence, while those who have a less veneration for the even-handedness of justice, will know in time to respect a tribunal to which they themselves may confidently appeal, and before which their own usurped rights may be vindicated.

To persons of inferior candour, and particularly to selfish plagiarists, we would recommend the perusal of the first paper in this Number, in which one of our most eminent Philosophers freely renounces to a foreigner the merit of discoveries which he had published, and believed to be his own; and also the communication from Mr Nicholas Mill, in p. 338 of this Number, in which he fixes the precise share which he and other philosophers have had in the improvement of the Platina Air Pyrometer.

1. *The Daily Variation of the Barometer not discovered by Colonel Wright.*

It will doubtless seem strange to our scientific readers, that the discovery of the daily variation of the barometer should be now, almost for the first time, made a question for discussion. Their wonder, however, will not be diminished, when we inform them, that a grave charge has been brought against the Editor of this work, against Mr Brande, and against Baron de Ferussac, for transferring the honour of this discovery from M. Godin to Colonel Wright of Ceylon; and when we give them the additional information, that this charge was made by M. Arago, one of the editors of the *Annales de Chimie*, at the time when he was occupying the President's chair in the Royal Academy of Sciences, our readers will see the necessity of repelling a charge, which, had it come from any other quarter, would have received that silent treatment which it merits.

As the notice which gave rise to this charge appeared originally in our Journal, and was merely copied from its pages into the *Quarterly Journal*, and into Baron Ferussac's *Bulletin*, it is necessary that the defence should proceed from us. The original notice in the *Edinburgh Philosophical Journal* stands thus:—

"Colonel Wright, member of the Ceylon Literary and Agricultural Society, *is said* to have discovered, that within the tropics *the mercury rises and falls twice within twenty-four hours, with such regularity, as to afford almost an opportunity of measuring the lapse of time by this instrument.*"—*Ceylon Government Gazette.*"

To those who understand English, it must be very obvious that the fact here announced is the extraordinary regularity of the rise and fall, which would render the barometer almost fit for measuring time. But M. Arago chooses to view it in quite a different light.

"*L' Edinburgh Philos. Journal,*" says he, conducted by *Dr Brewster,* "*le Journal de l'Institution Royale de la Grande Bretagne,* dirigé par le *Professeur Brande; le Bulletin Universel des Sciences et de l'Industrié,* publié sous la direction de *M. le Baron de Ferussac,* ont annoncé que suivant une DECOUVERTE faite par le Colonel Wright, le mercure du barométré, dans le voisinage de l'equateur, monte et baisse deux fois en vingt-quatre heures, avec une telle régularité, quon pourroit presque se servir de cet instrument pour mesurer le temps.

"Nous prierons ceux des lecteurs des *Annales* qui trouveraient que nous leur communiquons cette *découverte* un peu tard, de vouloir bien remarquer que Godin, Bouguer, et Lacondamine, l'avaient déjà faite il y a prés de cent ans; qu'après ces trois academiciens, presque tous les voyageurs aux regions equinoxiales s'en sont occupes; que M. de Humboldt a publié en 1807, un travail spécial et tres-precieux pour faire connaitre les veritables heures des *maxima* et des *minima* et l'étendue de l'oscillation (voyez *Geograph. des Plantes.*); que Lamanon, dans l'expedition de La Peyrouse, Horner, dans celle de Krusenstern, &c., se sont livrés à des recherches analogues; que par le secours des moyennes, Duc-Lachapelle, à Montauban, M. Ramond, à Clermont-Ferrand, les astronomes de l'Observatoire, à Paris, M. Marqué-Victor, à Toulouse, &c. &c., ont prouvé que cette oscillation diurne existe aussi dans nos climats; qu'enfin *nous ne manquons jamais,* dans nos resumés des observations meteorologiques de l'année, de donner les valeurs de l'abaissement journalier qu'eprouve le baromètre de neuf heures du matin a trois heures après midi, et du mouvement ascendant qui se manifeste entre cette dernière époque et neuf heures de la nuit.

"Apres avoir montré pourquoi nous n'avons point parle de la *pretendu découverte* du Colonel Wright, nous desirerions bien expliquer *quels motifs ont pu, au contraire, determiner les trois savans* que nous avons cités, a laisser insérer dans leur journaux l'annonce de cet officier sans y joindre aucune remarque; mais la tache nous parait difficile, et nous l'abandonnons à qui de droit."[*] *Annales de Chimie et de Physique,* Tom. XXV. p. 334.

The tone in which the preceding extract is conceived, cannot escape the observation of an English reader, and it mortifies us to think that the President of such a dignified body as the Academy of Sciences should permit himself to use the language of sneering, and contempt, in a question of pure scientific history. In calling the discovery of a British officer a *pretended* one, and in making reference to the *motives* of three gentlemen, whose only error could be the annunciation of what they believed to be a new fact in science, M. Arago has forgotten the courtesy which characterises Frenchmen, and has used language which, in our country at least, has been left to grace the oratory of the bar.

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[*] The greater part of this passage was translated in the *Annals of Philosophy.*

If we suppose that M. Arago did really misunderstand the true and obvious meaning of Colonel Wright's notice, he surely *could not for a moment believe* that the three editors whom he censures were ignorant of the daily variation of the barometer. With regard to the Editor of this Work, he had it in his power to correct his mistake, by looking into the *Edinburgh Encyclopædia,* (a work which he has quoted in some of his papers,) in which he would have found the daily variation of the barometer treated of in more than one place. With regard to Mr Brande, he could not but know that a gentleman like him, who held the important office of Secretary to the Royal Society, and who even lectured on subjects connected with meteorology, could not possibly be ignorant of the daily variation of the barometer; and with regard to Baron Ferussac, we have every reason to believe that the subject is as well known to him as to M. Arago.

Now, if any reader shall be so dull, as to imagine that we attributed the discovery of the diurnal variation of the barometer to Colonel Wright, or so unjust as to suppose that Colonel Wright *pretended* to any such discovery, we have only to assure them, that they have misinterpreted the plainest language.

We believe that this curious fact was first *distinctly* * noticed by M. Godin, and that M. de la Condamine pursued the discovery. After having mentioned Godin's observations, Condamine remarks,—"Je trouvai que vers le neuf heurs du matin le barometre étoit à sa plus grande hauteur, et vers trois heures après midi à le moindre; la difference moyenne etoit 1¼ ligne." —*Journal du Voyage,* &c. p. 109. See also p. 50.

From Godin's observations, the learned President passes *immediately* to the labours of Humboldt, and terminates with those of the astronomers of the Observatory, of which he himself is one; but in all this display of names, *no English name appears;* and the labours of *Mr Henry Trail, Mr John Farquhar,* (the celebrated proprietor of Fonthill, we believe,) and *Dr Balfour,* so early as 1794, are left in utter silence. This blank, however, we shall supply. Mr Trail had observed the daily variation in India earlier than 1794. Mr Farquhar, in 1794, observes,

"That after numerous observations, *at all hours* during the day and night, I found that the mercury is subject to the following variations, with the utmost degree of regularity throughout the whole year. From 6h A. M. till about 7 and 8 A. M. it is stationary: It then rises till 9 A. M. sometimes, though rarely, till 10 A. M. when it becomes stationary till noon: It then descends, and is lowest at 3 P. M. and continues stationary till 8 P. M. when it begins to rise, and continues till 11 P. M., and is then at the greatest height, as at 9 in the morning."—*Asiatic Researches*, vol. x. p. 196.

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* So long ago as 1666, Dr Beale observed that "very often, both in winter and summer, the mercury stood higher in the cold mornings and evenings than in the warmer mid-day." *Phil. Trans.* No. 9, p. 153, &c.

Beside the three periods mentioned in the above extract, Dr Balfour found a fourth, as described in the following Table:—

Barometer falls between	10 P. M.	and	6 A. M.
rises	6 A. M.		10 A. M.
falls	10 A. M.		6 P. M.
rises	6 P. M.		10 P. M.

Both Mr Farquhar and Dr Balfour considered these variations as connected with the diurnal revolution of the earth.

We may now add, that our countryman Colonel Wright seems to have discovered, that these changes are made with such extraordinary regularity, that the barometer may be almost used for measuring the lapse of time.

In concluding these observations, we would recommend it to M. Arago to desist from his repeated attacks upon English authors,* in which he seems to take a peculiar delight, and which can have no other tendency than to degrade science, and to exasperate national feeling, already too highly excited. If a love of justice prompts him to this species of petty warfare against England, how comes it that, in a paper on the *Polarisation of Light*, which he has written for the Supplement of the Encyclopædia Britannica, he has almost entirely forgotten to record the exertions of those who have laboured in that arduous field of inquiry. We can easily understand why he has done injustice to Dr Brewster. We can also understand why he has done injustice to Mr Herschel;—it is sufficient that they are both Englishmen. We can even understand why he has suppressed the labours of Dr Seebeck, for he is a German; but we cannot understand why the important discoveries of M. Biot, his colleague in the Academy, should have been so trampled upon and overlooked. Those who have followed that distinguished philosopher in his wide range of discovery; and who have witnessed the prodigious ardour and force of intellect which he has applied, to one of the most difficult branches of scientific inquiry, will never cease to wonder that a president of the Academy of Sciences should have dared to depreciate and suppress the labours of a man, who must ever be regarded by the philosophers of all nations, as one of the brightest ornaments of his country.

2. *Bryson's Compensation Pendulum, invented by Mr David Ritchie of London.*

In the article HOROLOGY of the *Encyclopædia Edinensis*, a compensation pendulum is described as the invention of Mr Bryson, watchmaker in Edinburgh. This pendulum consists of two compound bars of steel and brass placed at right angles to a steel pendulum rod, a little above the ball. As the steel rod lengthens by heat, these compound bars become more convex, and lift up the ball as much as it was depressed by the elongation of the rod. One of these pendulums is in use at the Albyn Club; but, though ingenious contrivances, we have not learned that they are superior to those invented by Elliott, Wood, Reid, and Troughton.

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* His attack upon the Rev. Dr Pearson was repelled by that able astronomer with great spirit, and we hope that Mr Forster will be equally successful.

The pendulum now under our consideration, is not the invention of Mr Bryson, but was invented by Mr David Ritchie of Clerkenwell, who received for it the medal of the Society of Arts, and who has published a full account of it, with drawings, in the *Transactions* of that body, vol. xxx. p. 176—182.

3. *Sir William Congreve's Moveable Ball Clock, invented by M. Serviere.*

The Cognoscenti in elegant mechanism have long been in the habit of admiring a beautiful time-piece, which bears Sir W. Congreve's name, (but whether with or without his sanction we know not), in which the minutes are indicated by the descent of a brass ball, along a number of inclined planes running alternately from right to left, and left to right, on the face of an inclined brass plate. When the ball reaches the bottom of the plate, after having described the last of the inclined planes, it releases a detent which tilts the brass plate, and inclines it in the opposite direction. The ball being now at the top of the system of inclined planes commences its retrograde motion, and when it again reaches the bottom, the plate is again tilted at the opposite position.

This clock was invented by M. Serviere, and is minutely described in various forms in a French work, which we have now before us, entitled *Recueil d'Ouvrages Curieux*, &c. Lyons, 1719. In all these clocks, however, the ball is carried up by machinery from the bottom to the top of the inclined plane, whereas, in Sir W. Congreve's, the plane is moveable, as above described, which is a very important improvement.

4. *Heulandite first separated from Stilbite by Professor Mohs, and not by Mr Brooke.*

In the *Ed. Phil. Journal*, January 1822, Mr Brooke has given an account of his determination of the radiated and foliated zeolite of Werner to be two distinct species, and he has given to the latter the name of Heulandite.

The merit, however, of first separating these two species, belongs to Professor Mohs, who published the results under the titles of *Prismatoidal* and *Hemiprismatic* Kouphone Spar, in his *Characteristic*, p. 59, which was translated and published in Edinburgh in the year 1820.

In Mr Brooke's *Familiar Introduction to Crystallography*, published in 1823, he has not taken the opportunity of mentioning the prior claims of Professor Mohs. Mr Phillips has also overlooked this, but we expect to see it in the next edition of his Mineralogy.

5. *Mr Nicholas Mill's Platina Pyrometer.*

We have much pleasure in laying before our readers the following candid and liberal explanation sent to us by Mr Mill, regarding the similarity which we pointed out in our last number between the Platina Hygrometer *proposed* by Dr Ure, and the Platina Hygrometer *executed* by himself.

"In the third number of your Journal, in commenting on an instrument which bears my name, you seem to intimate that I have laid claim to an invention which does not belong to me;* it becomes my duty, therefore, to explain where I rest my pretensions.

"The principle upon which I have perfected the Pyrometer, which is the subject of this letter, is the old-established principle of *expansion of air by heat*, and is analogous to the *Differential Thermometer of Sturmius*, claimed by Leslie, and also to the construction of the *common steam guage*, which acts by the pressure of steam against a column of mercury.

"The *principle* of the instrument, therefore, delineated by Dr Ure, is not new, and consequently does not belong to him. Although the suggestion of applying it to a Pyrometer unquestionably is his, I have never presumed to lay claim either to the one or the other. It is in the *mechanical construction* of this instrument that I claim any merit. Many difficulties presented themselves in its construction which could hardly have been anticipated by Dr Ure, and which required some little ingenuity to overcome. It was found that an air-tight screw in platinum could not be made to resist considerable pressure; it was, therefore, necessary to have recourse to a stem without a joint, which, after a considerable period, I accomplished. The internal diameter of the platinum bulb measured one half inch, whilst the stem proceeding therefrom was not the twentieth part of an inch internal diameter; and to construct this in a metal so difficultly fusible as platinum was pronounced an impossibility by the first philosophical instrument maker of this metropolis. It was also found, that, by uniting the platinum stem to a glass tube, as recommended by Dr Ure, it was useless in its application, because its frangibility was such as to render it liable to be broken by every trifling motion, independently of which, its position could not be accommodated to a furnace. It therefore became necessary to have a *moveable air-tight joint*, in constructing which no small difficulty arose, because the pressure of the confined air, when intensely heated, was so great as to force itself through common joints; but that obstacle was also removed; and the instrument, as it now appears, may be made to traverse in any position within the radius of a circle; and without it was so constructed, would, of course, be next to useless.

"I submit, under the circumstances above stated, that the principle of this Pyrometer belongs to *Sturmius*, the *delineation* of it to Dr Ure, and the *execution* of it to myself."

ART. XXXI.—HISTORY OF MECHANICAL INVENTIONS AND PROCESSES IN THE USEFUL ARTS.

1. *Mr Ritchie's Photometer, and the Illuminating Powers of Oil and Coal-Gas.*

AN account of this ingenious instrument, invented by Mr William Ritchie, Rector of the Academy of Tain, has been read before the Royal

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* We have merely pointed out the similarity of the two instruments.—ED.

Societies both of London and Edinburgh, and a particular account of it may be expected in the Transactions of one or other or both of these learned bodies.

Mr Ritchie's photometer is (like that originally proposed by Lambert in his Photometria in 1760) a thermometer which measures the heat produced by absorbed light, and is, therefore, liable to all the objections which Lambert and others have urged against the instrument as a measurer of different kinds of light. Our readers are well aware that Mr Leslie brought forward Lambert's photometer as an invention of his own, and proposed it as an instrument for measuring every kind of light, the light of the sun, (not the light of the moon,) the light of the sky, the light of snow, and the light of coal-gas, nay, even the light of the coloured spaces of the spectrum. Now, it is an admitted fact, that the *red* space in the spectrum (to say nothing of the rays beyond the red) shows greater heat by the thermometer than the *yellow* space, while the *yellow* space is far more luminous than the red. The thermometrical photometer, therefore, is incapable of measuring *different kinds of light*. Mr Ritchie, with a degree of candour not inferior to his ingenuity, admits at once that his photometer, which is fifteen or twenty times more sensible than Mr Leslie's, is positively incapable of measuring or comparing any other lights but those of the same kind; and he is now convinced, that it will not measure, except by a rude approximation, the relative illuminating powers of oil and coal-gas.

The principles on which this photometer depends are, that radiant heat does not pass through thick plates of glass, but is conducted through them in the same manner as through opaque bodies; that light expands in the same manner as heat the substances that absorb it; and that the intensity of light varies inversely as the square of the distance.

The Photometer shown in Plate IV. Fig. 10, consists of two broad flat cylinders, A, B, placed parallel to one another. These cylinders are air tight, being closed at their outer sides by a thick disk of glass, while their inner sides and their circumference consist of copper or brass, or sheet iron. Parallel to the glass disk there is stretched across each cylinder a disk of black paper. The cylinders are connected interiorly by a bent tube, DE, containing a small quantity of coloured liquor; and a scale is placed between the two branches of the tube which are vertical. By exposing the glass faces of the cylinders to two lights, the light falling on the disks of paper is absorbed; the air within the cylinders is heated proportionally, and the relative expansions indicated by the motion of the liquor towards the weaker light. This instrument is said to be sensible to the light of a candle at the distance of twenty or thirty feet, whereas Mr Leslie's shows total darkness at the distance of three inches.

In reference to the application of this instrument, Mr Ritchie remarks, "It would be a *vain attempt*," says he, "to endeavour, by the aid of this photometer, or that of Professor Leslie, to ascertain the value of the illuminating powers of oil and coal-gas, since the *qualities of the gas* are essentially different. When the flames are *nearly similar*, as in the case of oil and coal-gas, this instrument will give a pretty good approximation to their illuminating powers, but *unless the colour of the flames be exactly the same,* neither this method nor that of shadows can pretend to more than a mere approximation. I may here remark, that the results of my photometer, or of any other instrument founded on the expansion of air by its combination with light, will always be unfavourable to the illuminating powers of oil-gas compared with coal-gas, as it takes no cognizance of the *fine white colour of the flame* of the former compared with the more dusky colour of the latter. When the oil-gas is of a superior quality, and the coal-gas not well purified, *the results of this photometer, or that of Professor Leslie,* will be EXTREMELY WIDE *of the truth.* The indications of this instrument may give the quantities of light as *one* to *three,* whilst the illuminating power of the oil-gas is at least *five* or *six* times greater than that of the coal-gas."—See p. 321 of this Number.

2. *M. Ducom's Cylindrical Artificial Horizon.*

This ingenious instrument, which has already been put to the test of experiment by two able astronomers, Professor Simonoff and Baron Zach, has not yet been described by the inventor, but the general principle of the instrument may be deduced from two long dissertations upon it by Baron Zach.

The instrument consists of two parts, one of which is a copper disk of six inches in diameter, with three feet. The second part is a cylindrical cover or drum, which performs the part of the glass roof in the common horizons for sheltering the fluid from the action of the wind. From the middle of the first part, or copper disk, there rises a hollow cylinder of white iron 4½ inches high, and 2½ inches in diameter. Upon this cylinder, which is open at top, there is placed a small round disk of white iron, (or of boxwood, when mercury is used,) which goes into the top of the cylinder, but is prevented from descending by a ledge on which it rests. This disk contains the mercury, wine, or prepared syrup which is employed. These cylinders are adjusted in such a manner that the surface of the fluid is exactly 2½ inches above the first disk. On the copper disk are fixed two brackets, to which is fastened the cylindrical roof or drum. This drum, which is made of white iron, is six inches in diameter and 2½ wide, and is so placed that its centre is in the surface of the fluid in the round disk. In the middle of the width of the drum, there are two bands of white iron, perforated by two circular openings diametrically opposite to one another, and an inch in diameter, the one for letting in the incident rays, and the other for letting out the reflected ones. They have a circular motion by a rack and pinion on the surface of the drum, for the purpose of being adjusted to the height of the sun or the star.

When there is not much agitation in the air, two small funnels or truncated cones are placed in the small tubes in the circular apertures, and these have the effect of protecting the fluid surface from every agitation. When the wind is considerable, the funnels are kept on, and a small glass with parallel faces is placed at the end, by which means the incident rays are admitted; but if the wind is very high, the funnels are taken off, and a piece of wire gauze is placed in the tube. This permits the external air to be in regular communication with the internal air, which is favourable to the accuracy of the observation. See Baron Zach's *Corr. Astron.* vol. xi. p. 391 and 480.

3. *Mr Jeffrey's Method of condensing Smoke, Metallic Vapours, &c.*

This ingenious method, the efficacy of which is said to have been proved, is represented in Plate IV. Fig. 11. The letters BB represent the flue of any ordinary furnace through which the smoke rises. It is shut up at A, and after turning horizontally at C, it has a descending branch D, which terminates below at the opening F. The branch DD communicates at its upper end with a cistern E, having its bottom perforated with holes immediately above the flue.

As the heated current of air, charged with smoke and vapours of different kinds, descends in the branch DF, the constant shower of water from the cistern F carries down with it the smoke and all the sublimed matter from the fire, and the whole runs out through the opening F, in the state of black water, without any smoke. A strong current of air is created in the descending pipe by the descent of the cold water.

The flues B and D may be close to one another, or may stand at any distance, and in any relative direction. See *Journal of Science*, vol. xviii. p. 270.

4. *Casting of Wooden Ornaments and Veneers.*

A discovery is said to have been made in France of a method of converting pulverised wood or sawdust into a solid substance, by which curious wooden articles may be formed in moulds, at a small expence, out of rare and valuable woods. See Newton's *Journal of the Arts*, vol. ix. p. 35. The only difficulty which is opposed to such a method consists in obtaining a cement sufficiently cheap for holding together the woody particles. It is evident that such a composition can never possess any of the beauty of structure which is generally the principal one in rare kinds of wood, although a coarse imitation of this may be effected by particular combinations of different mixtures varying in colour.

5. *Account of the Lapidary's Wheel of the Hindoos.*

This wheel, used for cutting precious stones, is composed of one part gum-lac, and two parts of powdered corundum (or emery.) The corundum powder is first heated in an earthen vessel, and when the heat is such as to melt the gum, it is added in portions, the whole being stirred about to promote a perfect union. The paste thus made is beaten with a pestle on a smooth slab of stone; it is then rolled on a stick, and reheated several times. When the mixture is uniform, it is then taken from the stick and laid on the stone-table, which must be previously covered with fine corundum powder, and then flattened into the shape of a wheel with an iron rolling-pin: The wheel is then polished by a plate of iron and corundum powder, and a hole is made through the middle of it by a heated metallic rod.

When the wheel is mounted on a horizontal axis, the workman gives it a motion of rotation with a spring-bow, and holds the stone which he cuts in his left hand, applying, occasionally, corundum powder and water. The polishing is effected by leaden wheels, and a finer powder. M. De La Tour, *Mem. du Museum*, tom. ii. p. 230.

6. *Dr Church's New Boring Auger.*

This patent auger, of which the specification is not yet enrolled, is the invention of Dr Church of Birmingham. One of these instruments, which has been tried by Mr Newton, a competent judge of its merits, is one inch and one-eighth in diameter. When turned like a gimblet by the right hand, it passed through a four inch dry deal, four inches thick, in fifty seconds. With the assistance of a bow, it penetrated a post seven inches square, in twenty-one seconds. It cuts a perfectly smooth hole, and clears itself as it advances. It can be sharpened upon an ordinary grindstone, and will retain the same form and properties though ground down within a short distance of the stem. Newton's *Journal of the Arts*, vol. ix. p. 91.

7. *Evans's New Method of Roasting Coffee.*

This process, for which a patent has been taken out by Mr R. Evans of London, consists in preventing any of the oily parts of the coffee which contain the aroma, from evaporating during the process of roasting it. The machine consists of a cylindrical vessel turned by a winch and two wheels. It has ledges within to throw the beans from the side to the middle of the cylinder. At the middle of the cylinder, opposite to the handle, a tube passes from the open air to beyond its centre, having a great number of perforations in it. During the first period of the roasting, the aqueous parts, which the heat drives off, pass through the holes of this tube; but, when all the water is driven off, this tube is shut up, and, consequently, during the last period of the roasting, the aromatic oil does not escape from the beans.

In order to ascertain the precise time when the aqueous vapours are dispelled, he holds a piece of slate against the outer end of the tube with perforations, and the deposition upon its surface, if watery or gummy, shows whether the water or the oil is escaping. Small quantities of the beans are occasionally taken out with a spoon through the axle, to observe the progress of the operation. An abstract of the specification is published in Newton's *Journal of the Arts*, vol. ix. p. 72.

8. *Braconnot's Process for making Blacking for Leather.*

M. Braconnot has published, in the *Annales de Chimie, &c.*, for November 1824, p. 333, the following process for making a superior and cheap blacking for leather of all kinds. Take

Plaster of Paris passed through a fine sieve of silk, -	100 parts.
Lamp black, - - - - - - -	25
Malt used by brewers, - - - - -	50
Olive oil, - - - - - - -	5

The malt must be first macerated in water nearly boiling, to obtain its soluble particles. The plaster and lamp black are then mixed in a basin with that liquid, and when it is evaporated to the consistency of paste, the olive oil is mixed with it, and a little oil of lemons or lavender is added to perfume it. In place of plaster, an equal quantity of common potter's clay may be used.

9. *Mr Jenning's Improved Gas Burner.*

This ingenious contrivance, the object of which is to close the passage for the gas, even if the stop-cock has been heedlessly left open, and thereby prevent all smell, and all risk of forming an explosive mixture, is shown in section in Fig. 12, Plate VIII. The gas rises up the passage *a* of the socket *cc*, and is prevented from passing into the burner by the ball *b*, which shuts the passage. In order to allow the gas to pass, the burner is lifted up by the hand, which raises the ball *b* out of its place, and the gas passes from *a* into *d*, and up the tubes *ee*. When the gas has burned about a quarter of a minute, the pin *f* becomes hot, and the heat is conveyed to the bent arm *g*, which will curl up, as shewn by dotted lines, in consequence of the different expansions of the two dissimilar metals of brass and steel, of which it is made. The ball being thus drawn aside from its seat, the burner may be let down from its raised position, and the gas will continue to flow. When the flame is extinguished, the pin *f* and the bent arm *g* become cold, and the uncurling of the latter brings the ball into its seat and closes the passage for the gas, even if the cock has been incompletely shut, or afterwards carelessly opened.—See Newton's *Journal of the Arts*, vol. ix. p. 179.

ART. XXXII.—ANALYSIS OF SCIENTIFIC BOOKS AND MEMOIRS.

I. *Description of a Monochromatic Lamp, with Remarks on the Absorption of the Prismatic Rays by Coloured Media.* By DAVID BREWSTER, LL.D. F. R. S. Lond. and Sec. R. S. Ed. &c.

On the Absorption of Light by Coloured Media, and on the Colours exhibited by certain Flames, &c. &c.[*] By J. F. W. HERSCHEL, Esq. Sec. R.S. Lond. and F.R.S. Edin.

THE composition of the solar rays has exercised the sagacity of philosophers since the discovery of the different refrangibility of the rays of light by Newton; and though unquestionably it is to that great man that we owe the first and prominent fact of the nonhomogeneity of white light, yet much has been added to his discoveries by later research, and properties and peculiarities, of which he had not the least conception, have been found to belong to the several parts of which the spectrum consists, and the media capable of transmitting light.

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[*] These two papers are printed in the *Edinburgh Transactions*, vol. ix. p. 433 and 445. It will give us, as well as our readers, great satisfaction to hear frequently from the able correspondent to whom we are indebted for this analysis.—ED.

The first great discovery, in this line, since Newton's time, was the difference of the dispersive powers, by which different media, under equal angles of refraction, separate the extreme rays unequally. Hence the possibility of that grand improvement in practical optics, the achromatic telescope. But this is far from a perfect instrument, and, if we carry the magnifying powers of our telescopes beyond a certain extent, we speedily become sensible of the limit which the nature of the media, of which its lenses consist, places to our further progress. In microscopes, however, achromatic lenses had rarely, if ever, been adopted, and in these, accordingly, the original imperfection of refracting telescopes existed in all its force. To obviate the inconvenience of chromatic aberration in these instruments, two methods occurred to Dr Brewster, viz. Either to extinguish all the rays, but those of one colour, by the use of coloured glasses, and thus to destroy the erratic light before its entry into the eye; or, 2dly, To use homogeneous light *ab initio* for the illumination of the object viewed. The former of these methods, however, is either imperfect, or is attended with the loss of so much light, as to render vision obscure, and, though affording a certain degree of advantage, Dr Brewster was induced to abandon this method for the above reasons.

The discovery of a source of homogeneous light next occupied his attention, and, after numerous trials, he ascertained the remarkable fact, that almost all bodies in which the combustion was imperfect, such as paper, linen, cotton, &c. gave a light in which the homogeneous yellow rays predominated—that the yellow light increased with the humidity of these bodies—and that a great proportion of the same light was generated, when various flames were urged mechanically with a blow-pipe or pair of bellows. He thence concludes, that the yellow rays appear to be the produce of an imperfect combustion. We may observe, however, that combustion is not necessarily imperfect in the flames above enumerated. Most inflammable bodies, moreover, in a state of incipient or weak combustion, discharge, not a yellow, but a blue flame. The blue flame, at the bottom of a candle, is known to every one; that of burning sulphur (in its usual weak state of combustion) is hardly less familiar; and the deep blue flame of a piece of paper, scorched on the under side till the upper takes fire, is matter of wonder and delight to every child who plays with fire. It is only when the combustion becomes full and violent that the yellow light begins to *predominate* in flames. Mr Herschel observes, that sulphur, urged to the utmost intensity of combustion, by projecting it into a white-hot crucible, discharges a homogeneous yellow light, but as the intensity of the heat diminishes, the blue and green spectra appear. The flame of oil urged by bellows, (in which state its combustion is undoubtedly most complete,) has been observed by Mr Fraunhofer, (in a conversation with ourselves,) as well as by Dr Brewster, to consist principally or wholly of yellow light. Be this as it may, the remark that aqueous vapour present in a flame increases the quantity of yellow light, which, we believe, no one before Dr B. had made, is curious and important, and furnished him with what he was in search of—a monochromatic flame. *Diluted alcohol* is the pabulum he proposes to employ, and his paper contains a description and drawing of a convenient lamp, for maintaining and managing its combustion with perfect facility.

Mr Herschel appears to have entered on a somewhat similar inquiry, having felt the want of some standard homogeneous light in the course of optical researches of another nature. He remarks, that the flame of an ordinary spirit lamp consists of two portions, a yellow cone enclosed in a blue envelope, but projecting above it, so that the upper part is purely yellow, the lower a mixture of yellow and other faint rays. If, however, it be viewed through a combination of a pale green with a pale orange glass, it appears purely yellow, and if enclosed in a lanthorn of such glass, becomes a monochromatic lamp.

In the course of their investigations, both authors were led to examine the action of differently coloured media on the spectrum. The results at which they arrive agree in many points. We shall state the principal of them.

1. All coloured media absorb some rays of the spectrum in preference to others, and the quantity absorbed depends on the thickness of the medium.

2. The quantity of any coloured ray, transmitted by a homogeneous medium, decreases in geometrical progression as the thickness increases in arithmetical progression.

3. Every medium has its own peculiar scale of action on the series of differently refrangible rays, or its own peculiar *ratio* of the geometrical progression above mentioned for each degree of refrangibility.

4. In consequence, as the thickness of a medium varies, the tint changes, and this truth, which at first sight appears paradoxical, and never fails to surprise when experimentally shown, is general. That ray in the spectrum which is least energetically absorbed will, of course, penetrate through the greatest thickness, and its ultimate tint will be a homogeneous one of this particular refrangibility.

5. The energy with which coloured media attack the different rays is not only not the same, in all parts of the spectrum, but, moreover, follows no regular law of progression in proceeding from one end of the spectrum to the other. Dr Brewster has given coloured drawings (to which the engraver or colourer cannot have done justice) of spectra, seen through various media. Mr Herschel represents the intensity of a ray transmitted through a medium of given thickness by the ordinate of a curve, taking that of the intromitted ray for one, and the length of the spectrum for the abscissa. This curve appears in numerous cases to have several maxima and minima, in consequence of which, the media it represents have really two or more distinct colours, and undergo not merely a change of shade by an increase

of thickness, but a positive transition from one hue to another. Thus, a solution of sap-green, viewed through small thicknesses, is green, but in great ones is dark red, and numerous other media present this singular transition.

Mr Herschel proposes the extreme red as a standard ray for optical experiments, not that exhibited by common red glasses, which is always a mixed colour, but that transmitted with particular facility by ordinary deep blue glass coloured by cobalt. Its place is strictly at the utmost limit of the spectrum, and its refrangibility (when insulated by a combination of such a glass with a red one) definite, as much so as the yellow light above described. Dr Brewster has investigated the effects of heat in changing the tints of media. He has observed different glasses to be differently affected by heat, some having their absorbent powers increased, and others diminished—some transiently, and others permanently. Many minerals present similar phenomena. The experiments of Dr Brewster on topaz are well known. The change of colour in many opaque bodies by heat is doubtless referable to this cause. We need only mention minium and the peroxide of mercury, which, at a heat just short of ignition, become almost black, and recover their bright red hue when cold.

In both the papers now before us, the insulation of the yellow rays in solar light by coloured glasses, in a state of perfect purity, is regarded as impracticable; but both these authors have succeeded in so far separating it, as to place the existence of yellow light in the spectrum beyond all manner of doubt, and in showing that the space it occupies is really pretty considerable. Dr Brewster, indeed, regards it as encroaching both on the limits of the red and green, and Mr Herschel attributes to it a breadth not less than one-fourth, the interval between the red and blue. The former draws the conclusion, that the orange and green are really composite colours, which, if verified, would be a fact of the highest importance, in as much as it would prove the prismatic analysis of white light to be imperfect, and refer the impression of colour on the sensorium to some other cause than that which produces difference of refrangibility. We do not mean to deny this, for, in fact, we think there are other arguments adducible in its support. We submit, however, that the celebrated observation of Dr Wollaston, on which the opinion advanced by Dr Brewster is grounded, must have contained some cause of fallacy. He received in his eye the spectrum of a narrow luminous line, and could discern in it no yellow, or so very little as to be attributed by him to a mixture of red and green from the opposite sides of the aperture.

Nevertheless, if the red and green portions of a long prismatic spectrum be screened, the yellow is rendered very evident; and in Fraunhofer's admirable experiments, (which we had the pleasure of witnessing in perfection at Munich through his kindness,) where, from the exquisite limpidity of the prisms used, and the delicate adjustment of his whole apparatus, the absolute homogeneity of every part of the spectrum is fully assured, the orange, the yellow, and the green, are all seen shading into each other by insensible gradations; the yellow being remarkably conspicuous, and of a pale straw colour. In a beautifully coloured plate, or rather map, of the spectrum before us, in which every part is laid down by M. Fraunhofer, from exact micrometrical measurements, the portion occupied by the yellow is 22, the length of the whole spectrum being 286, and the interval between the red and blue about 77.[*] Mr Herschel's estimate agrees well enough with these measures. We may here take occasion to remark, that although upwards of seventeen years have elapsed since the first discovery of black lines in the spectrum by Wollaston, none of the continental opticians, with whom we have had opportunities of conversing, seemed aware of their having been known previous to the elaborate researches of the eminent artist just mentioned.

Annexed to Mr Herschel's paper is a determination of the dispersions of a variety of specimens of flint and crown glass, (by a peculiar and simple method, founded on the same principle as the double image micrometer,) which are considerably above the usual estimates. The dispersion assigned by Fraunhofer are still higher, as might be expected, from the superiority of his means of examining the spectrum at its limits. Indeed, it is to his "Determination of the refractive and dispersive powers of different species of glass, &c., &c.," that we must refer for all accurate knowledge on this important subject.

II. *Some Account of the late M. Guinand, and of the Important Discovery made by him in the Manufacture of Flint Glass for Large Telescopes.*— London, 1825, 25 p.[†]

THE little pamphlet, of which we propose at present to give an abstract, is filled with details of the most interesting kind, both to the philosopher and the general reader.

The discovery of a method of making Flint Glass for achromatic telescopes has been, during the last seventy years, an object of almost national ambition. In England, unfortunately, the strictness of our Excise laws prevented any attempt from being made on a proper scale to solve this great practical problem; but in France, where no such restrictions existed, numerous attempts have been made to perfect the manufacture of flint-glass for optical purposes. To what extent these experiments succeeded, we have not sufficient information to enable us to ascertain; but we believe it is universally admitted, that the difficulty was neither surmounted, nor in the way of being surmounted, when M. Guinand, of the village of Brenets, in the canton of Neufchatel, began those laborious researches, which were finally crowned with the most complete success.

We shall, therefore, proceed to give a brief history of the life and labours of this interesting person, abridged from the details in the pamphlet under our consideration.

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[*] An engraving of the spectrum, as laid down by Fraunhofer, with most of the lines which cross it, will be found in the *Edinburgh Encyclopædia*, Art. OPTICS, vol. xv. p. 548. PL. 433.—ED.

[†] This pamphlet is a translation from an article in the *Bibliotheque Universelle* for February and March 1824.

About 70 years have elapsed since M. Guinand was employed in assisting his father as a joiner. At the age of thirteen he became a cabinet-maker, and occupied himself chiefly in making clock-cases.

At this period he had become acquainted with a buckle-maker in his neighbourhood, of whom he learned the art of working in various metals, which enabled him, about the age of twenty, to attempt the construction of a watch-case; and, having succeeded, he followed the occupation of a watch-case-maker.

Having constructed clock-cases for M. Jaquet Droz, he saw, at the house of that mechanist, a fine English reflecting telescope, an instrument then very rare in Switzerland. M. Guinand was then in his 20th or 23d year, and it cannot be doubted that this circumstance first turned his mind towards that subject to which he afterwards devoted his attention. Having expressed a wish to take this telescope to pieces, that he might examine it in detail, M. Jaquet Droz gave him permission, and undertook to put it together should that task prove too difficult for him. M. Guinand took the instrument to pieces; measured the curves of the mirrors and glasses, and afterwards readily put it together; then availing himself of his experience in casting ornaments for clock-cases, he attempted the construction of a similar telescope; and his second experiment succeeded so well, that it was impossible to determine whether his telescope or its model was the best.

M. Jaquet Droz, surprised at this success, asked our artist what treatise on optics he had followed as his guide; but he was still more surprised when the young man told him that he was not acquainted with any; he placed one in his hands, and it was not until this period that M. Guinand studied, or rather deciphered, (for he read with difficulty,) the principles of that science.

Having been always weak-sighted, he found, when he began to make watch-cases, that his spectacles were no longer of service; and, being directed to a person whose glasses were said to have given great satisfaction, he obtained a pair which really suited him no better than the others; but, by looking on while they were in progress, he learned the art of forming and polishing the lenses. He therefore undertook to make spectacles, not only for himself, but for various other persons. This new acquirement he found very useful in his favourite pursuit; and he amused himself in manufacturing telescopes of an inferior quality, for which he made the tubes of pasteboard.

The discovery of achromatic glasses having reached that country, it could not fail to be interesting to M. Guinand. M. Jaquet Droz, having procured one of these new glasses, permitted M. Guinand to take it to pieces, and to separate the lenses. It will readily be conceived that the purpose of the latter was to construct a similar instrument, but in this he was disappointed, by the difficulty of procuring glasses of different refractive powers. It was not until some years afterwards, that an acquaintance of his, M. Recordon, having gone to England, where he took a patent for his invention of self-winding watches, which were then in great request, brought him, from that country, some flint-glass; and though the specimen was much striated, he manufactured from it some good achromatic glasses. Having obtained supplies of this material on various occasions, and having seen other glasses besides those of M. Jaquet Droz, he easily ascertained that flint-glass, which is not extremely defective, is rarely to be met with. Convinced of the impossibility of procuring it of that quality which he wished, and having become skilled in the art of fusion, he melted in his blast-furnace the fragments of this flint-glass; no satisfactory result was obtained, but he discovered, from some particles of lead, which re-appeared during the process, that this metal was a constituent in the composition of flint-glass. At the time of this first experiment, he had attained his 35th year. The ardent desire to obtain some of this glass then induced him to collect such notions of chemistry as might be useful to him; and, from 1784 to 1790, he employed a part of his evenings in different experiments, melting, at each time, in his blast-furnace, three or four pounds of glass; in every experiment he took care to note down the substances and proportions of his combinations, the time of their fusion, and the degree of heat to which he had subjected them; so that, by an examination of the results, he endeavoured to discover the causes which had rendered his products defective. While occupied in these researches, he derived a strong incentive to perseverance, from the prizes which he understood to have been offered for this desideratum by different academies. At a later period he also learned the almost total impossibility of procuring flint-glass exempt from striæ, which impressed him with the importance of the discovery at which he was aiming.

Having relinquished, at the age of forty, the trade of watch-case-maker for that of maker of bells for repeaters, at that time very lucrative, (since he could make as many as twenty-four in a day, for which he was paid five francs each;) he resolved to prosecute his experiments on a more extended scale. Having purchased a piece of ground on the banks of the river Doubs, near Brenets, where his establishment is at present situated, he constructed a furnace capable of melting two hundred weight of glass, and he settled there with his family, in order to dedicate his leisure to new experiments.

His perseverance, however, had to overcome many untoward accidents. At one time, his furnace threatened to burst while heating, and he was obliged to rebuild it with materials procured from abroad; at another time, he noticed an essential defect in its construction, which obliged him to suspend the melting; sometimes his crucibles, which he had procured at great expence, or manufactured himself, cracked without his being able to discover the cause, and the vitreous matter was lost. These fruitless attempts discouraged him on some occasions, but on others, excited him so as to deprive him of rest, and he meditated day and night on the probable causes of the accidents, and on the means of obviating them. At length, however, he obtained a lump of glass, of about two hundred weight; having sawed this lump vertically, he polished one of the sections, in order to examine what had taken place during fusion. On the upper surface of the vitreous matter there were many little semi-globules, which had the appearance of drops of water, terminating by a thread or little tube of greater or less depth, at the extremity of which there was a small spherical bulb. The cause of this appearance was, that these drops and tubes consisted of a denser kind of glass than the rest. In another part, there arose from the bottom of the crucible other cylinders or tubes, terminating also in a kind of swelling or bulb; these had a hollow appearance, because they were formed of a substance less dense than the rest of the glass; and lastly, here and there were seen specks or grains ending with a tail, of a substance less dense than the rest of the mass; these, on account of their appearance, he denominated *comets*.

Having often seen on the surface of his glass small globules of lead, he supposed that certain particles of the lead which enters into the composition of his vitreous matter separate from it, and appear on its surface in their metallic state; that becoming again oxydated by contact with the air, or re-calcined after being revived, they combine with the vitreous matter on which they rest, and thus form that glass of greater density which appears on the surface in the form of drops. The specific gravity of this substance causes it to sink to the bottom of the crucible; but, in descending more or less slowly, according to the temperature of the furnace, it leaves in its passage a train which occasions those threads of glass that possess a stronger refraction. Having reached the bottom, this vitreous matter, in some degree saturated with minium, attacks the substance of the crucible, and forms with it a vitreous compound of an inferior density to the mass, and ascending, in consequence of its specific levity, produces those cylinders or tubes, formed of a less refractive glass. Lastly, when this solvent, by melting the substance of the crucible, especially that of the bottom, has detached from it a grain of sand or baked clay, this half molten grain rises and floats in the mass in an oblique direction, because, being still attached to a part of the vitreous matter which it has produced, it is not actuated on all its points to ascend with equal rapidity.

Whatever may be thought of this explanation, the question was, how to remedy the non-homogeneity of strongly refractive glass; and it was here, in particular, that M. Guinand had great obstacles to surmount. Having, after many expensive trials, been so fortunate as to obtain glass of which some parts were perfectly homogeneous; and, therefore, destitute of those striæ of which flint-glass is so rarely free, he reflected on the different circumstances which, in this experiment, might have contributed to the result, so that, in subsequent attempts, he obtained blocks of glass possessing larger portions of homogeneous substance, and he has almost arrived at a certainty of obtaining in the fusion of from two to four hundred weight of glass, at least one-half of it perfectly homogeneous, and, consequently, fit for optical purposes.

M. Guinand admitted that his processes had not yet attained all the perfection which might perhaps be desired; but as he has by these means succeeded in making disks, perfectly homogeneous, of twelve, and in one instance even of eighteen inches in diameter, and having no doubt that, in operating on a greater scale, he might easily be able to obtain one of a diameter double or triple the extent of those last mentioned, he concludes that his process has at length removed the obstacle which the non-homogeneity of flint-glass opposed to the construction of large achromatic object-glasses.

When M. Guinand first obtained blocks including portions of good glass, his practice was to separate them, by sawing the blocks into sections that were horizontal, or perpendicular to their axis; then polishing the sections he selected the portions adapted to his purpose, and returned the others to the crucible; but, independently of its tediousness, and the waste occasioned by sawing, this process was attended with the disadvantage of not cutting the finest parts of his glass in the manner best calculated for large disks; for frequently the most homogeneous parts were thus divided. A fortunate accident, however, of which he availed himself, conducted him to a better process.

While his men were one day carrying a block of this glass on a hand-barrow to a saw-mill which he had established at the fall of the Doubs, at the distance of half a league from his house, the mass slipped from its bearers, and, rolling to the bottom of a steep and rocky declivity, was broken to pieces. M. Guinand was at first grieved at this misfortune, but having selected those fragments which appeared to be perfectly homogeneous, he softened them in circular moulds in such a manner, that on cooling he obtained disks that were afterwards fit for working. To this method he adhered; and he contrived a way of cleaving his glass while cooling, so that the fractures should follow the most faulty parts. When flaws occur in the large masses, he removes them by cleaving the pieces with wedges, he then melts them again in moulds, which give them the form of disks, taking care to allow a little of the glass to project beyond one of the points of the edge, so that the optician may be enabled to use that portion of glass in making a prism, which shall give him the measure of the index of refraction, and thus obviate the necessity of cutting the lens. The refraction of M. Guinand's glass varies almost at every casting, while, on the other hand, that of each casting is of such homogeneity, that the refractive force of two pieces taken indifferently, one from the top and the other from the bottom of the crucible, is absolutely the same.

M. Guinand removes the defects by means of the wheel; then by re-softening the disks, the vitreous matter expands and fills up the hollows that have been made; if, after polishing, he finds them still defective, he repeats the process until the disks are perfect. By these means he has often succeeded in soldering pieces of glass which have left no trace of their separation: at first these pieces were only cemented; there was frequently even air or sand between the united surfaces; in these cases, he cut along the line of junction a small semi-cylindrical groove, in order that the vitreous matter, while melting, might fill it, not by flowing from its edges to the bottom, but by raising the bottom itself, and by repeating this operation he declares that he has succeeded in totally effacing all traces of junction.

M. Guinand, having visited Paris in 1798 or 1799, presented to the late M. de Lalande several disks of from four to six inches of the glass which he obtained in sawing his blocks, (not having at this period thought of the expedient of remelting them ;) that celebrated astronomer advised him to work them up himself, so as to demonstrate the goodness of his glass. M. Guinand followed this advice, and while continuing his manufacture of bells for repeaters, he pursued for several years the making of glass and the working of lenses; he constructed achromatic telescopes, some of which had object-glasses of four or five inches, free from striæ; and having purchased a small water-mill at Brenets, he adapted it to the polishing of his glass.

Though his success was not publicly known, yet he was visited by several men of science. Having in this way become acquainted with Captain Grouner, of Berne, the latter had occasion when in Bavaria to speak of the labours of M. Guinand, and, a short time afterwards, in 1804, he asked him, on the part of M. Fraunhofer, the director of the celebrated establishment of Benedictbauern, for some specimens of his glass. M. Fraunhofer, after examining them, and requesting several disks of the glass, was so well satisfied with them as to repair to Brenets, a distance of 260 miles, where he engaged M. Guinand to go into Bavaria. Having arrived in 1805, he determined to settle there; and during a residence of nine years he was almost solely occupied in the manufacture of glass.

After having discontinued for several years subsequent to his return all his optical labours, his taste for the pursuit revived, and from that time he was alternately occupied with the manufacture of glass and the construction of telescopes.

Among the opticians who have used this glass may be mentioned M. Lerebours, a French artist, who, during a visit to Brenets in 1820, obtained all the glass which M. Guinand then had, and was so well satisfied with it that he requested a fresh supply, and made overtures for obtaining the process. We may also mention M. Cauchoix, who, in a notice relative to the telescopes in the last exhibition at the Louvre, has spoken highly of the flint-glass of which they are constructed. When the *Bibliothèque Universelle* announced the formation of the Astronomical Society of London in 1821, M. Guinand was requested to present to them a sample of his glass, upon which they made a report as favourable as the small size of the specimen could warrant; they also offered to make another, on disks of a larger dimension. M. Guinand accepted the offer, and they have now in progress a disk of seven inches.*

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* Among the telescopes made by M. Guinand after his return to Switzerland, there are several of remarkable magnitude and effect; in general the greater part appear to advantage on a comparison with English telescopes; a merit which is owing in an especial manner to the quality of the glass. But the most singular circumstance is, that they have been constructed by an old man of seventy-six years of age, who himself manufactured the flint and crown glass, after having made with his own hands his vitrifying furnace and his crucibles, who, without any mathematical

This disk of seven inches was wrought, by that able artist Mr Tully, into an object-glass twelve feet in focal length; and in his report to the Astronomical Society, on the 25th January 1825, he says, that he has not quite succeeded in working the glass to his mind, and adds, "But I have no doubt I shall be able to make it into a very perfect instrument; the glass seems entirely homogeneous and free from fault. The material of the glass," he continues, "appears to be different from our flint-glass, as it grinds and polishes much easier. I have another piece of flint-glass 3½ inches, of the same manufacture, that seems likewise to be quite free from fault, and *is as clear all over* as any fluid."

To the preceding interesting particulars we regret to add, that M. Guinand died, after a short illness, about the end of 1823, and about the 76th year of his age, immediately after arrangements had been made with the French government for the purchase of his secret. His son fortunately possesses all the details of the process, and is ready to supply opticians with glass for object-glasses of large apertures.

ART. XXXII.—NOTICES OF RECENTLY PUBLISHED PERIODICAL BOTANICAL WORKS.

Monandrian Plants of the Order Scitamineæ, by William Roscoe, Esq. No. 2.

THE second part of this valuable publication appeared during the year 1824, and it fully justifies the expectations which we had entertained from the well known talents of its author. The plates we consider to be executed in better style than those of the first number. It contains *Canna compacta*, n. sp.;—*Canna pedunculata* of Lodd. Bot. Cab.—*Maranta gibba*, Sm. in Rees' Cycl. *Hedychium acuminatum*, n. sp. *Hedychium Gardnerianum* of Dr Wallich, (a most superb plant;) *Kæmpferia rotunda*, Curt.—*Curcuma Amada* of Roxb. Fl. Ind.:—and *Globba saltatoria* (Mantisia saltatoria of Curtis.)

Drummond's Musci Scotici.

The second volume of this useful work, some of the contents of which were noticed, previous to its publication, in our second number, has now appeared.

Botanical Magazine for December, No. 458.

TAB. 2531. *Crinum arenarium* β. from Australia. t. 2532. *Pergularia sanguinolenta*, Lindley in Hort. Trans. t. 2533. *Hamelia patens*,

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knowledge, devised a graphic method of ascertaining the proportion of the curves that must be given to the lenses, afterwards wrought and polished them by means peculiar to himself; and, lastly, constructed all the parts of the different mountings either with joints or on stands, melted and turned the plates, soldered the tubes, prepared the wood, and compounded the varnish.

Linn. t. 2534. *Cyrtanthus striatus,* a new species, but with a specific character ten lines in length; native of the Cape. t. 2535. *Paliurus virgatus* of Don's Fl. Nepal. t. 2536. *Clerodendrum macrophyllum:* introduced by Mr Barclay from the Mauritius.

Hooker's Exotic Flora, for December, No. 17.

Tab. 133. *Callicarpa longifolia,* Lam., but not, we think, of Roxb. Fl. Ind.; from the Liverpool garden. t. 134. *Murraya paniculata* of Malag. Misc., communicated from the Hort. Soc., who received it from Sumatra. t. 135. *Habenaria gracilis,* Colebrooke, mss.: native of Sylhet, E. Indies. t. 136. *Habenaria marginata,* Colebr. mss., found growing on the turf at the Bot. Garden, Calcutta. t. 137. *Balsamina setacea,* Colebr. mss. native of the mountains N. of Sylhet. The three last plants have not been introduced in our gardens.

Loddige's Botanical Cabinet, Part 92, December.

No. 911. *Veronica taurica.* 912. *Hæmanthus multiflorus.* 913. *Arnica scorpioides.* 914. *Potentilla glabra.* 915. *Asphodelus creticus.* 916. *Primula sinensis.* 917. *Erica viridiflora.* 918. *Clematis angustifolia.* 919. *Mespilus acuminata.* 920. *Lachenalia bifolia.*

Part 93, January 1825.

No. 921. *Maranta bicolor.* 922. *Persoonia flexifolia.* 923. *Jasione perennis.* 924. *Cactus speciosissimus.* 925. *Habenaria blephariglottis.* 926. *Erica Carniola.* 927. *Cymbidium lancifolium.* 928. *Styrax officinale.* 929. *Orobus hirsutus.* 930. *Spigelia marilandica.*

Greville's Scottish Cryptogamic Flora.

The notice respecting the Nos. of this work will be inserted in the next Number of our Journal.

BOTANICAL INTELLIGENCE.

Progress of Botany in Russia.

We learn from a little work that has lately been published at Moscow, by the celebrated Hoffman, entitled, "*De Fatis et Progressibus rei Herbariæ, imprimis in imperio Rutheno,*" that the Sovereigns of Russia, since the time of the first Emperor Paul, have been great protectors of the sciences. They have engaged learned men upon expeditions which have included the whole empire. Under Peter I., Messerschmidt of Dantzic was the first who made a voyage to Siberia, for the advancement of knowledge. The physician, G. Schobers, visited the banks of the Wolga, and the coasts of the Caspian Sea. Christopher Buxbaum, (after whom *Buxbaumia* is named,) member of the academy, extended his researches thence to the Black Sea and Asia Minor. The Empress Anne, more anxious to cultivate the soil, and to become acquainted with the treasures of nature, than to extend the bounds of her domain, sent Trangott Gerber, director of the Botanic Garden of Moscow, to the mountains of Orenbourg, and of Tartary: but, of still more consequence was the embassy which she dispatched to Kamtschatka, and to the coasts of America, under the command of the famous navigator, Behring, a Dane, who was accompanied by the naturalists, J. G. Gmelin * and Stephen Kraschenninnikow. Five years after, Stephen and W. Steller of Weinhaim, in Franconia, visited the Bay of Awatcha, and the north-west coasts of America, whence they brought very interesting collections of plants. Gmelin again, in company with G. F. Müller and Di l'Isle de la Croyére, accomplished their travels into Siberia, in the years 1734 and 1743.

Under the reign of the Empress Catherine, new expeditions were undertaken into the north of Asia, and throughout all Russia, by Pallas, Falke, Grendelstedt, Georgi, Lepechin, and Hablizl. The Floras of Siberia, and of the Altaic mountains, were enriched by the researches of a Swede, Eric Laxmann; that of Livonia, by Grindell, Germann, and Drümpelmann; that of Petersburgh, by Sobolewsky, Leboschütz, and Trinius, (well known by his labours among the grasses,) that of Moscow, by Stephen, Martins, Adams, Fischer, and Goldbach. The Caucasus was visited many times by Marshal Von Bieberstein, whence originated the *Flora taurico-caucasica*. Other learned botanists have published their discoveries in the Memoirs of the Society of Natural History; these are Londes, de Victingshoff, Haas, Wilhelms, Parrott, Engelhardt, &c. Botanic Gardens have been established, and kept up with greater or less care at Abo, in Finland, at Casan, Charkow, Cremenery in Volhynia, at Dorpat, Moscow, Wilna, Warsaw, St Petersburgh, &c. Among those of the last mentioned city, that of Paulowsky stands pre-eminent, as containing the rarest plants brought from very distant countries, by the recent Russian navigators. To these remarks, which were published in 1823, we are enabled, through the kindness of our excellent friend Dr Fischer, and of Mr Goldie, to add some notices respecting the truly princely establishment of the new Imperial Botanic Garden of St Petersburgh, founded in 1824.

The celebrated Botanic Garden of Prince Razomoffsky, at Moscow, which was under the direction of Dr Fischer, at the death of that nobleman excited no interest in the mind of his son, and Dr Fischer then used his utmost exertion to have a Botanic Garden worthy of the Russian empire, established at its capital, St Petersburgh. This, happily, through the intervention and influence of the Empress mother, a great lover of Botany, and who herself possesses a very fine collection of plants, was accomplished.

Upon one of the small islands formed by the branches of the Neva, to the north of the town, and named, from the circumstance that we are about to mention, Aptekerski stroff, (Apothecary's Island,) was founded by Peter the Great, a small garden for the cultivation principally of such plants as were useful in medicine, and which was given to the Company of Apothecaries. Here Peter built, with his own royal hands, a hut which still exists, and planted several trees, especially of Poplar and Lime, which have attained a considerable size, and are preserved with a sacred care. This spot, consisting of good soil, and watered upon one side by a branch of the Neva, was fixed upon as the scite of the present garden. Other ground, however, was added to it in 1823, so that it includes an area of sixty English acres, in part surrounded by a wooden fence, and partly by a hedge, which occupies an extent of about two hundred yards next the river.

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* Author of the excellent *Flora Sibirica*, and of *Travels through Siberia.*

In 1824, a series of operations were commenced and carried into execution, such as perhaps have scarcely any parallel in the annals of Botanical Institutions. Orders were given for ranges of Greenhouses, Conservatories and Stoves, the cost of which was estimated at a million of roubles, (about L.40,000 Sterling,) and the whole to be completed before the present winter.

The principal houses are three in number, facing the south, each 700 feet in length, and twenty to thirty feet from back to front, placed in parallel lines, but at such a distance from each other, that by two other houses of the same length, running from north to south, and placed at the ends of these, the whole forms a parallelogram, measuring 700 feet each way, intersected by a central line or house of the same length. The middle building is the most lofty, being forty feet high in the central part. The three that face the south have a sloping light in front, reaching from the top to the ground.

Those which run north and south have a double roof, are comparatively low, and have the path in the centre. All are heated by means of common flues, and with wood, principally birch. Water is raised by engines from the river, and cisterns filled in various parts of the houses, and in the most convenient situations. The large spaces of ground, or areas between the buildings, are filled with shrubs, and flower-beds; only, behind the most southern one is a splendid suite of apartments for the Royal Family. These have windows, opening from above into the house below, so that the plants may be seen to great advantage.

Dr Fischer, who has the charge of the establishment, occupies at present a small wooden dwelling within the garden. Handsome and commodious habitations are to be built for him, and for the two chief gardeners, one of whom is a Dane, and the other a Frenchman. Two Secretaries are employed, one of them is a French gentleman, M. Fleury, who lately visited this country with Dr Fischer, the other a Russian; and also an excellent botanic painter, a native of Germany, who has already executed some very beautiful drawings of new and rare plants.

There is scarcely a garden in Europe, which will not, if it has not already done so, contribute to stock this superb establishment. The collection is even now very great. One hundred thousand roubles were appropriated for the purchase of plants, at the commencement; and 68,000 roubles annually, for the ordinary expences. During the last year, which, as we have seen, was the first of the commencement of the institution, no less than 14,000 packages of seeds were sown in 60,000 pots. Dr Fischer paid a hasty visit to England and Scotland in last autumn, and collected so great a number of living plants, (above 4000,) that he engaged Mr Goldie of the Monkwood Nursery, near Ayr, to take charge of them during the voyage, and to assist in their transplantation. This was successfully accomplished, and on Mr Goldie's quitting St Petersburgh in October, the whole collection was in a most thriving condition.

We have inquired in vain for correct information respecting the state of this noble institution, since the late inundations of the Neva, but we can hear nothing certain. We dare not flatter ourselves with the expectation that it can have escaped without severe, very severe injury; but we do earnestly hope that the report which has been circulated, respecting its utter destruction, will prove to be as much exaggerated as those early accounts which we received of the loss of lives and of property by the same dreadful calamity.

It is satisfactory to be able to announce, that Dr Fischer has provided very extensive materials for the publication of a Flora Rossica. His long residence in Moscow, and the great intercourse which subsists between the Eastern and Southern parts of Russia and that city, gave him facilities in obtaining possession of plants which no other naturalist has had the means of acquiring. No stranger, it is well known, can explore any part of Russia, with a view to science, without express permission from the Emperor, and this is not easily obtained. But strict orders have been given for the plants to be collected by those resident in the respective districts, throughout every part of the Russian dominions, and to be transmitted to the new garden. Besides which, collectors are to be sent purposely into Siberia, and other remote parts of the empire, at the expence of Government.

Intelligence from Austria.

By a letter which we have just received from Professor Jacquin of Vienna, we learn that the Fasciculi 3d and 4th of his "*Eclogæ*" have been published; and that some more Fasciculi yet will appear in the course of the present year.

The Botanical Public have long been in expectation that Dr Host, author of the superb work entitled *Gramina Austriaca*, would publish a Monograph, on a similar plan, of the *Salices* of Austria. We have the pleasure of being able to state, that the first volume of this publication, containing 100 coloured plates, will appear during the present year. It will be completed in two volumes, comprising 250 plates. The same author is engaged in preparing a new *Flora Austriaca*, to serve as a second edition of his Synopsis.

M. Pohl has ready for publication, a numerous collection of drawings of Brazilian Plants, and M. Schött of Ferns, from the same country.

Intelligence from North America.

In addition to the information which we gave in our last Number relative to American Botany, we have the satisfaction of being able to state, that

Dr Schweinitz and Mr Halsey are engaged in collecting materials for a Cryptogamic Flora of that country.

Denmark.

The valuable work which Professor Schow has written in the Danish language, upon the Geographical Distribution of Plants, with maps, has already been translated into German, and Professor De Candolle is about to publish a French translation.

Dr Nolte, an excellent and zealous botanist of Lauenbourg, who, at the expence of the King, has botanized during many years in Holstein and Lauenbourg, is engaged upon a *Prodromus Floræ Holsatiæ-Lauenbourgensis.* The same author will soon publish a treatise upon the *Hydrocharideæ* and the *Alismaceæ* of the North of Europe, upon which he has made many interesting observations.

Professor Hornemann is employed in preparing a new edition of his *Hortus Hafniensis,* and a 2d part of his *Œconomical Flora of Denmark.*

Professor Schumacher has written a treatise upon the Genus *Cinchona,* and has nearly finished his book in Danish upon *Medicinal Plants.*

M. Schonsboe, Consul of Legation and Danish Consul-General at Tangiers, already well known as an excellent Botanist, has for many years studied the Marine Algæ of the coast of Barbary, and will now publish a particular work upon that subject, for which plates have been already engraved.

Lieutenant Holbölt of the Royal Danish Navy, and son of the head gardener at the Botanic Garden of Copenhagen, has lately made a large collection of plants on the coast of Greenland. During his passage to that region, he fell in with the British Discovery Ships, and was presented by Captain Parry with a copy of the supplement to his first voyage. This circumstance was the more gratifying to the young Botanist, as, upon his return to Copenhagen, and even so late as the month of December, no copy of that work had reached Denmark.

Sweden.

Wahlenberg has edited at Upsal a Flora Suecica.

Mexico.

The important political changes that have taken place in Spanish and Portuguese America seem already to have had an influence upon the literature of those countries. Our excellent friend, Mr Barclay of Bury Hill, Surry, has obligingly communicated to us the 1st No. of an important botanical work, which is just printed at Mexico, entitled "Novorum Vegetabilium Descriptiones, in lucem prodeunt opera Paulli de la Llava, et Joannis Lexarza, Reip. Mexic. CIV." This first part includes descriptions of 40 new species, of which 13 constitute as many undescribed genera. The *greater number* of the plants are among the *Compositæ.*

Art. XXXIII.—PROCEEDINGS OF SOCIETIES.

1. *Proceedings of the Royal Society of Edinburgh.*

December 6.—The following gentlemen were elected Ordinary Members:

Dr John Campbell, Physician in Edinburgh.
George Anderson, Esq. Inverness.

At this Meeting Mr Haidinger read a paper on the Determination of the Idea of the Species in Mineralogy, according to the principles of Professor Mohs, the particular object of which was mentioned in our last Number.

December 20.—At this Meeting there was read Additional Observations on the Natural History and Physical Geography of the Himalayah Mountains. By George Govan, M. D. This paper is inserted in this Number, p. 277.

January 3.—At this Meeting Robert Brown, Esq. was elected an Honorary Member of the Society.

There was also read by Dr Hibbert, a paper on the Dispersion of Stony Fragments remote from their native beds, as displayed in a stratum of loam near Manchester. This paper is printed in this Number, p. 208.

At the same Meeting Mr Haidinger read a Description of *Fergusonite*, a new mineral species. For a notice of this mineral, named in compliment to Robert Ferguson, Esq. of Raith, see p. 375.

January 17.—At this Meeting Mr P. F. Tytler read extracts from a Journal of Travels through Persia, by Mr James Baillie Fraser.

February 7.—The following gentlemen were elected Ordinary Members:

Major Leith Hay of Rannes.
Rev. John Williams, Rector of the Edinburgh Academy.
John Hugh Maclean, Esq. Advocate.

At this Meeting there was read a Description of *Withamite*, a new mineral species found in Glenco. By Dr Brewster. This paper is published in this Number, p. 262.

February 21.—There was read an Account of a Sepulchral Urn, containing fragments of bones and a boar's tusk, found near the village of Rathen in Aberdeenshire. By John Gordon, Esq. of Cairnbulgh.

The sepulchral urn described in this paper was circular, resembling in shape a ball of about thirteen inches in diameter, cut through about four inches from the top. It was nearly filled with the remains of human bones in small particles, together with a considerable quantity of dry earthy matter. The urn was surrounded by upright stones about a foot and a half in length, on the top of which was placed a flat one, resembling the one on which the urn stood. The boar's tusk was perfectly sound and entire when found; but in about a month it cracked, and broke in one or two places. About fifteen or twenty years ago, several similar urns were dug up; but we have not learned that any boars' tusks were found in them.

There was also read a Description of a new Photometer, with its application. By Mr WILLIAM RITCHIE, Rector of the Academy of Tain. See p. 339.

At the same Meeting there was read a paper on the First Introduction of Greek Literature into England after the dark ages. By PATRICK FRASER TYTLER, Esq.

March 7.—The following gentlemen were elected Members :

Foreign Members.

M. Mitscherlich, Professor of Chemistry in the University of Berlin.

M. Gustavus Rose, Professor of Mineralogy in the University of Berlin.

Ordinary Members.

Dr William Preston Lauder, Physician in Edinburgh.

Right Honourable Lord Ruthven.

Dr Edward Turner, Fellow of the Royal College of Physicians, and Lecturer on Chemistry, Edinburgh.

At this Meeting was read a paper on the Neptunian Formation of Siliceous Stalactites, by the Rev. Dr FLEMING. This paper is printed in this Number, p. 307.

2. *Proceedings of the Cambridge Philosophical Society.*

May 3, 1824.—A communication was read from C. BABBAGE, Esq. F. R. S. Fellow of the Cambridge Philosophical Society, on the Determination of the General Terms of a new class of Infinite Series.

A paper was also read by G. B. AIRY, Esq. Fellow of the Camb. Soc. on the Construction of a new Achromatic Telescope.

May 17.—A communication was read from J. HOGG, Esq. Fellow of the Camb. Phil. Soc. on two Petrifying Springs in the neighbourhood of Norton, in the county of Durham.

A paper was read by G. B. AIRY, Esq. Fellow of the Camb. Phil. Soc. on the Principle and Construction of the Achromatic Eye-Pieces of Telescopes, and on the Achromatism of Microscopes.

May 24.—A paper was read by Dr HAVILAND, President of the Cam. Phil. Soc. on the Cases of Secondary Small-Pox, and of Small-Pox after Vaccination, which have occurred in Cambridge during the last year.

A paper was read by the Rev. Professor FARISH, Vice-President of the Camb. Phil. Soc. on a Method of obviating the Inconveniencies arising from the Expansion and Contraction of the Iron in Iron Bridges.

May 25.—Being the anniversary meeting of the Society, the following officers were appointed for the ensuing year :

Dr Haviland, Regius Professor of Physic, *President.*

Dr F. Thackeray,
Rev. W. Farish, Jacksonian Professor,
Rev. J. Cumming, Professor of Chemistry, } *Vice-Presidents.*

Rev. B. Bridge, *Treasurer.*

Rev. G. Peacock, Tutor of Trinity,
Rev. J. S. Henslow, Professor of Mineralogy, } *Secretaries.*

Rev. W. Whewell, Tutor of Trinity, *Steward of the Reading Room.*

Council.

J. King, Esq. Tutor of Queen's,
Rev. A. Sedgwick, Professor of Geology,
M. Ramsay, Esq.
Rev. J. Studholme,
Rev. R. Crawley, Tutor of Magdalene,
Rev. R. Jeffreys,
Rev. J. P. Higman, Tutor of Trinity.

Nov. 15.—A communication was read by Rev. Professor CUMMING, on the Use of Gold Leaf in the Detection of Magnetism.

A paper was read by Rev. W. WHEWELL, Fellow of the Camb. Phil. Soc. on the Principles of Dynamics.

Nov. 29.—A communication was read by Rev. Professor CUMMING, on the History of Electro-Magnetism.

Dec. 13.—A paper was read by Rev. Professor FARISH, Vice-President, on the Construction of the Cogs of Wheels, and also on the Action of Wheels with Cogs in the Form of Involutes of Circles.

3. *Proceedings of the Society for Promoting the Useful Arts in Scotland.*

Dec. 21, 1824.—The Rev. Mr SOMERVILLE of Currie gave an account of his contrivances for preventing the accidental discharge of fire-arms, and exhibited to the society various guns to which they were applied.

There was read also a Description of the original Machine for Drying Linen, invented by the late Mr JAMES WATT, and communicated by him to Dr Brewster.

An Account of Mr THOM of Rothesay's New Double Valve Sluice was read. See this Number, p. 288.

Professor WALLACE read a Report on Mr Burnet's Trigon for solving Problems in Navigation.

Jan. 4, 1825.—There was read a Report by Professor WALLACE, Mr KINNEAR, and Dr BREWSTER, on Mr Sommerville's Contrivances for Preventing the Accidental Discharge of Fire-Arms.

A Description of the Single Valve Sluice, invented by Mr THOM of Rothesay, was read.

Jan. 18.—Mr THOMAS CLARK described to the Society his new Quicksilver Pump, without Friction, and exhibited the Pump in Operation. See this Number, p. 267.

Mr JAMES JARDINE gave his Report on the New Fangate Sluice, invented by M. Blanker, and described the principles of its construction. An account of it by Professor MOLL will be given in our next Number.

Feb. 8.—A Description of Dr Dyce's Universal Balance was read, and the Balance itself exhibited.

A notice of the late Mr STODART's Alloys of Steel with Gold, Silver, Platina, and Rhodium, was read, and specimens of them were exhibited to the Society, with a view of exciting some of our artists to direct their attention to this important branch of the arts.

Feb. 22.—There was laid before the Society a Drawing and Description of an Improved Mortice Lock, invented by Messrs JOHN and THOMAS SMITH of Darnick, near Melrose. This lock exhibited much ingenuity, and possesses many advantages over the common one.

Mr WILLIAM GALBRAITH, A. M. gave an account of a method whereby, with a small additional apparatus, Hadley's sextant may be converted into a dip sector. This improved sextant was exhibited to the Society.

Mr JOHN BROSTER described to the Society his Apparatus for conversing with the Deaf and Dumb, and exhibited it to the Society.

March 8.—A Description of a Boat with a Revolving Paddle Scull, invented by ANDREW WADDELL, Esq. of Hermitage Hill, was read, and a model of the boat was exhibited to the meeting.

The MODEL which accompanied Mr Waddell's paper, is from the *Plan* of a French corvette, or sloop of war, and is on a scale of one-fourth of an inch to a foot; but although this vessel measures above 300 tons, her real burden is much less, being constructed with a very sharp bottom, for the purposes of fast sailing. With this model, many of Mr Waddell's experiments were made, and by the revolving scull at present fixed to the stern, the greatest velocity has been produced. It is of the same construction as that used in the boat with which the experiments were made on the Wet Dock at Leith, as described in this Number, p. 206. Each of the paddle-plates of the scull, according to the scale of the model, have a surface of eighteen feet, or thirty-six square feet in both.

The accompanying common paddle-wheels, of fifteen feet diameter, when fixed on the end of the *Axle*, in the centre of the model, and set in motion, produce a propelling surface nearly double that of the scull, notwithstanding which, the scull propels the model with a velocity of ninety English feet in sixty-four seconds of time, while the common paddle-wheels above stated, take eighty seconds of time to perform the same; and the moving power applied to both, is a small clock-spring with a train of wheels. See p. 206.

Mr SHIELL gave a Description of his very ingenious Triangle used at the late Fire for elevating the Jet of the extinguishing Engine, and exhibited a Model of it to the Society.

The following articles of foreign and domestic manufacture were exhibited to the Society:

1. Several specimens of Wood Screws, of French manufacture, with specimens of German ditto.
2. Specimens of French Glue.
3. Specimens of Painted Canvas from Antwerp.
4. Specimens of Gelatine from a manufactory near Paris.
5. Specimens of Woollen Cloths from MM. Terneaux of Paris.
6. Specimen of a stuff made from the produce of the Cashemire Goats introduced into France by Messrs Terneaux.
7. Specimens of a very cheap manufacture by the same.
8. Specimens of cheap Sheffield Cutlery.

ART. XXXIV.—SCIENTIFIC INTELLIGENCE.

I. NATURAL PHILOSOPHY.

ASTRONOMY.

1. *Remarkable Double Tail in the Comet of* 1823.—As this singular fact has been observed both in Europe and America, there can be no doubt of its truth, and therefore the particular details of it become very interesting to the Astronomer. This phenomenon was observed by several persons at Newhaven Connecticut, on the evening of January 23, and previous to this by President Day of Yale College. The faint stream of light which was seen to extend from the comet towards the sun, was not directly opposite to its usual tail, but inclined at an angle of 178½° or 178° to it. In its brightness and length it was variable, being sometimes visible only near the nucleus of the comet, and at other times extending to as great a distance as the usual tail. It was, however, narrower, and was supposed by some to converge to a point. It was observed again, through a very clear atmosphere, on the morning of the 27th, when both were fainter than before, but it retained the same relative position. It vanished a little before the tail of the comet, after having been a few days visible.

The very same phenomenon was observed by M. de Biela at Prague. He first saw it on the night of the 22d January, and also on the 25th and 27th, but neither before nor after. He describes the stream of light as a tail turned towards the sun, and he says that the two tails were not exactly opposite to each other, but forming a very obtuse angle. The new tail was neither so brilliant nor so long as the usual one. See Professor Silliman's *Journal*, vol. viii. p. 315.

2. *Supposed Influence of Comets on the Sun's Surface.*—M. de Biela conceives that he has observed an effect produced on the luminous state of the sun by the proximity of comets, and he is said to have observed the increase of spots on its surface when comets have approached to their perihelion.

3. *Periodical Comet of* 1819.—According to the calculations of M. Damoiseau, the following are the elements of the comet at its return in 1825.

Passage of Perihelion, September 17	084
Eccentricity	0.8449784
Long. of Perihelion	157° 14′ 30″
Long. of Node	334 22 8
Inclination of Orbit	13 23 29
Mean Daily Motion	1070″. 0866
Half of the Greater Axis	2.223611

The following ephemerides of the comet will enable us to find it in 1825, though there is little reason to hope that it will be seen during that period, as its elongation from the sun varies from 49° to 33° in the interval embraced by the following table. After it passes its perihelion it is still less likely to be seen. In the autumn of 1828, however, it will be visible over all Europe.

		R. Asc.	N. Decl.	Dist. from Earth.	Dist. from Sun.	Comp. Light.
1825, July 14.	075	59° 6′	28° 47″	1.775	1.345	0.175
24.	073	70 5	30 52	1.597	1.198	0.273
Aug. 3.	086	84 15	23 56	1.439	1.041	0.445
13.	087	99 48	23 44	1.316	0.874	0.597
23.	061	118 5	21 28	1.243	0.697	0.647

Connoiss. des Tems, 1827, p. 223, 224.

4. *Depression of the Horizon at Sea.*—In an interesting notice by M. Arago on this subject, he compares the differences between the calculated and observed depression with the differences between the temperature of the air and the sea as observed at the same time. When the calculated depression is greater, the errors are called *positive*, and when they are less, *negative*. M. Arago found that the error of the computed depression will be positive in a climate where the temperature of the air exceeds that of the sea, but that the negative errors are observed indiscriminately in all relative temperatures of the air and the sea. *Connoiss. des Tems*, 1827, p. 319.

OPTICS.

5. *Refractive Power of Dry and Humid Air.*—M. Arago has found by a particular method, that the refractive power of humid air differs a very little from that of dry air, the elastic force of each being the same. *Connoiss. des Tems*, 1827, p. 320.

6. *Polarisation of Light from Solid or Fluid incandescent Bodies.*—M. Arago has observed, that the rays which issue from solid or fluid incandescent bodies are partly polarised by refraction, when they form with the surface of emergence an angle of a small number of degrees. The light of combustible gases presented no traces of polarisation. Hence M. Arago concludes, that a considerable portion of the light of incandescent bodies is formed in their interior, and at depths which he has not yet completely determined. *Ann. de Chim.* tom. xxvii. p. 89.

7. *Optical Phenomena observed by M. Ruppell.*—In observing the eclipses of the stars by the moon, near the ruins of Solib in Upper Egypt, M. Ruppell had, on the 4th of June, directed his large telescope to the obscure limb of the moon. Close to it he observed a star of the 5th magnitude, which was about to be eclipsed by the moon. When it was near the limb, and on the point of disappearing, he observed, to his great surprise, that the star of the 5th magnitude was divided into two smaller ones of the 8th magnitude, which he saw with extraordinary distinctness. A few seconds afterwards they successively immerged behind the moon's limb. M. Ruppell asks, was this distinctness of vision produced by the atmosphere of the moon? Baron Zach explains this effect by saying, that M. Ruppell saw the star better, and consequently double, (for we presume it was really a double one,) in consequence of his looking longer at it; but this can never be considered as an explanation of the *extraordinary* distinctness of

which M. Ruppell speaks. If M. Ruppell first saw the star near the margin of the field, and afterwards saw it near the middle of it, the explanation would be easy; but it is necessary to suppose that the *distinctness* in question arose from the proximity of the star to the moon. It is by no means impossible that the dispersion produced by the lunar atmosphere might correct the uncorrected colour in the telescope, if such uncorrected colour existed.

8. *Remarkable Dichroism of Axinite.*—The dichroism of this mineral has already been observed, and mentioned in the *Philosophical Transactions* for 1819, p. 20; but Mr Haidinger has observed in Mr Allan's Collection a crystal from Cornwall, in which it is very remarkable, and he got it cut for the purpose of exhibiting it to advantage. By looking through the faces *rr'* of the figures of Axinite in Hauy and Mohs, there is a line inclined towards the face *t*, where common light transmitted through the plate is a minimum, and of a dark red colour, but not polarised, or rather consisting of two superimposed pencils polarised in opposite planes. By continuing the inclination towards *t*, the light becomes brighter and whiter, and all polarised in one plane, as if transmitted through a bundle of glass plates. By inclining the plate in the opposite direction towards *x*, the very same effect is produced. These effects are obviously owing to the absorption of one of the pencils by the crystal, as described in the Article OPTICS, of the *Edinburgh Encyclopædia*, Vol. XV. p. 601.

9. *Optical Structure of Somervillite.*—This interesting mineral species, which we have already described in this Journal, Vol. I. p. 187, has one axis of double refraction, as it ought to have by the optical law of primitive forms. The action of that axis upon light is negative, by the examination of the rings, and the double images, as it ought to be by another optical law. The separation of the images is easily seen through the faces P and *a*, in our Figure, Vol. I. Plate VIII. Fig. 4. Somervillite contains several crystallised cavities, when examined by the microscope. For the specimen with which we made the preceding observations, we have been indebted to Dr Somerville, whose name it bears.

MAGNETISM.

10. *Magnetic Variation at Lake Superior.*—The following observations have been made by Mr Thompson, astronomer to the Boundary Commission:

	W. Long.	N. Lat.	Easterly Variation.
Point Marmoaze, -	84° 34′	47° 7′	6° 0′
Thunber Point, - -	89 4	48 20	1 0
Fort William, - -	89 22	48 22	6 6½
Grand Portage, -	89 42	47 58	
31 Miles west of Grand Portage,	-	-	2 0
River St Louis, -	92 10	46 44	5 0
Ninigan Bay, - -	88 0	48 56	Compass much disturbed.

The preceding observations seem to have been made in 1822.

11. *Magnetic Declination at Paris in* 1822 *and* 1823.—The declination of the needle at Paris, in these years, was,

1822, Oct. 9th, 22° 11′ 1823, Nov. 20th, 22° 23

The last observed dip of the needle at Paris seems to have been in 1814, when it was 68° 36′.

METEOROLOGY.

12. *Great Inundation in Sweden and at St Petersburg.*—There are few events in the physical world that have excited so much attention, and done so much mischief, as the tempest of the 18th and 19th November 1824, and the extraordinary inundation which accompanied it.

The storm began on the coasts of England and Holland, and, after having occasioned numerous shipwrecks on the north coast of Jutland, it advanced to Gottenburg and Stockholm, keeping more and more to the direction of N. W. and S. E.

On the 13th and 14th Nov. the barometer at Stockholm fell lower than it had ever been seen, below even that which took place at the great earthquake of Messina in 1783. On the following days the sky was cloudy and the weather variable; but on the night of the 18th, and morning of the 19th November, a storm arose, which, after wrenching the vessels from their moorings, dashed them against each other, unroofed houses, and covered the roads with uprooted trees. A sheet of the copper roof of the palace of the Princess Sophia, about sixteen yards long, was carried off to the square of Gustavus Adolphus. Twenty-five ships, which were lying near the bridge of Munlbron, on Lake Maelar, was carried away with the bridge, and submerged.

Analogous effects were experienced at Gottenburg, Vibourg, and Udewalla on the 18th. At Udewalla the sea rose *eight* feet above the greatest elevation, and its motion was so rapid, that many persons had not time to escape. In the higher parts of the town, whole houses were carried away, and some ships were transported into the fields, 4000 feet from their anchorage. One vessel of 150 tons was actually wrecked in the middle of a street.

At Christiania, on the 18th, at 7h P. M., the waters of the Firth rose suddenly more than three yards above their mean level. After producing terrible destruction, they sunk suddenly below their ordinary level; but next day they rose again with such rapidity, that a new inundation was apprehended in the lower part of the town, as well as in the fauxbourgs of Waterland and Lierdingen.

For several days before the tempest appeared at St Petersburg, gusts of wind from the S. W. carried off several roofs in Wassili-Ostrow. On the 18th the storm increased, and the waters of the Neva rose to the height of the parapets. At 9h A. M. of the 19th, they quitted their channel, and spread themselves over all the town to such a height, that, on the quay of the Neva, the lamp-posts were not visible. All the wooden-bridges, great and small, were carried away, and the houses inundated to the height of ten feet, and even to the height of five feet in the higher parts of the city.

Entire houses tumbled down, and four-wheeled carriages were hurried away by the waves. Barks of the largest size were carried over the quays, and shipwrecked in the middle of the city, where boats were ready to collect the unfortunate inhabitants of the lower stories. A brig remained overset in the middle of the street of the Grand Perspective. The parapets along the banks of the river, which were built of enormous blocks of granite, were opened in several places. The wind was so violent, that it rolled up like sheets of paper, and carried off the plates of white-iron, which covered the roofs of the houses.

To the distance of five leagues from St Petersburgh, the rise, and the fury of the waters, were not less remarkable. Near Catherinoff, a whole village was carried away, and a number of country houses were destroyed.

At Cronstadt the sea everywhere rose fourteen feet, and the imperial fleet of twelve ships and four frigates, which lay in the Roads, were torn from their cables, and dashed upon the coast. A ship of 100 guns disappeared entirely. The wooden batteries were wholly razed on the side opposite to the sea, and those built with stone were greatly injured. The gun-carriages, separated from the cannon, floated on the waves.

These facts will enable us to form some idea of the extraordinary rapidity of this torrent and its elevation. The following particulars will show the extent of the devastation, and of the losses which accompanied them, and of the number of human victims which perished.

A whole regiment of carabineers, men and horses, was drowned. The carabineers had ascended the roof of the barracks for safety, but they were all swept away.

At the foundry of M. Clark, four versts from the city, on the road of Peterhoff, the workmen perceiving too late the progress of the waters, saw their own habitations, containing their wives and their children, swallowed up by the sea. More than fifty bodies were extricated at that place.

The number of sufferers has been estimated at from 500 to 700, and the loss at 150 millions, (of roubles we presume). Among these losses are mentioned 15,000 tons of hemp, 500 oxen, 200,000 quintals of hemp, 2,460,000 lbs. of sugar.

All these ravages, which have been compared to the destruction sustained by Moscow in the late war, were produced between nine A. M. and three P. M. The rise of the waters was sixteen feet, whereas in 1777, when a similar disaster happened, the rise was only fourteen feet.

This phenomenon has been ascribed to one of two causes; by some to the effect of the wind in accumulating and pushing up the waters of the river, and by others to some subterraneous convulsion. This last opinion is supposed to be countenanced by the sudden elevation and depression of the sea at Christiania, by the spontaneous breaking forth of new springs in the Upper and the Lower Rhine;—by crevices which have been opened in the solid ground;—by a slight earthquake which was experienced at Portsmouth and in the Alps; and by the volcanic eruption of Donnersberg, which, for the first time, discharged flames and ashes.

13. *Great Rain at Manchester in 1824.*—According to the accurate observations of M. Dalton, the following extraordinary quantities of rain fell during the four last months of the year:—

September,	- -	5.440 inches.
October,	- -	6.896
November,	- -	5.510
December,	- -	7.835
Total,	-	25.681

The mean annual quantity of rain at Manchester is only about 34 inches.

14. *Diurnal Variation of the Barometer at Marseilles.*—M. Gambart, the astronomer at Marseilles, has announced, that, in the year 1823, the diurnal variations of the barometer have been the same as in the Torrid zone.

CHEMISTRY.

15. *Deoxidating property of the Vapour of Water.*—Professor Pfaff, of Kiel, has observed that nitrate of silver assumes a yellow or even a deep brown colour, by exposure to the vapour of pure water; but the change of colour does not appear till the solution is raised by the vapour to the boiling point. M. Pfaff attributes these changes of colour to deoxidation, for the following reasons: 1. The similarity of the changes to those produced by light. 2. The disappearance of the colour by the addition of nitric acid. 3. The production of the same effect by the vapour of water upon other metallic solutions, which are easily deoxidated by light or by any chemical action. 4. The disengagement of oxygen gas during the process. The most convincing proof, however, according to M. Pfaff, is furnished by a solution of gold, so diluted as scarcely to retain a yellow tint. The vapour of water causes it to assume a fine blue colour, perfectly similar to that produced by a tincture of galls. The acetate of silver is much more feebly discoloured thon the nitrate. M. Gay-Lussac remarks upon these results, that they do not leave a complete degree of conviction. He says, that it is not necessary to make the vapour of water pass over the solutions, but that their ebullition is sufficient. *Ann. de Chim.* tom. xxviii. p. 215.

16. *Quantity of Heat disengaged during Combustion.*—In his remarks on respiration, M. Despretz has found, that hydrogen gas in burning melts 315.2 times its weight of ice, and carbon 104.2. It is remarkable, as M. Welter observes, that the number 315.2, and 104.2, are almost rigorously proportional to the weight of oxygen absorbed by the hydrogen and the carbon. For, from the chemical proportions of Berzelius, supposing the first number 315.2, the second will be 104.066. This observation is favourable to the conjecture of M. Welter, *that the quantities of heat disengaged in combustion, are in definite proportions.*—See the *Ann. de Chim.* tom.

xix. p. 425. M. Welter observes, that in the combustions which he has mentioned, that of carbon deviates most from the law, whereas by Despretz's experiments, it is the one which deviates the least.—See *Ann. de Chim.* tom. xxvii. p. 223.

17. *On the Colouring Matter, called Chica, by the Indians.*—The chica, with which the Indians of Rio Meta and the Orinoco paint their bodies red, is obtained by boiling the leaves of the Bignonia Chica for a long time in water. The red feculent matter is quickly precipitated by adding some pieces of the bark of a tree which is common in the savannahs of Meta, and is called *arayana.* The red matter is then carefully washed, and before drying, it is put up in round cakes, from five to six inches in diameter, and from two to three high; in which form it is met with in common. M. Boussingault remarks, that they have begun to employ chica in dyeing. When fixed in cotton, it gives it a yellow orange colour.—See *Ann. de Chim.* tom. xxvii. p. 315.

18. *Avogadro's Table of the Affinities of Bodies for Caloric.*

Oxygen,	1.0000	Chlorocyanic acid,	1.2901
Nitric acid,	1.0596	Oxide of carbon,	1.4265
Oxygenated chloric acid,	1.0693	Oxalic acid,	1.4296
Nitrous acid,	1.0700	Cyanogen,	1.4384
Chloric acid,	1.0840	Hydrochloric acid,	1.4805
Hyponitrous acid,	1.0847	Peroxide of hydrogen,	1.6464
Deutoxide of chlorine or chlorous acid,	1.1068	Carbon,	1.6819
		Hydro-cyanic acid,	1.8295
Nitrous gas,	1.1073	Acetic acid,	1.9676
Protoxide of azote gas,	1.1464	*Point of true neutrality,*	2.0041
Protoxide of chlorine or euchlorine,	1.1465	Water,	2.2219
Chlorine,	1.1800	Ammonia,	3.1296
Carbonic acid,	1.1860	Olefiant gas,	3.1566
Phosgene gas, or chloroxi-carbonic acid,	1.2120	Carburetted hydrogen,	4.2648
		Hydrogen,	12.0674
Azote,	1.2299		

Memorie della Reale Academia de Torino, tom. xxviii. p. 68.

19. *Avogadro's Table of the Neutralizing Powers of different Substances.*—In the following table, the acidifying or acid neutralizing powers, are marked with the sign —; and their alkalinity, or neutralizing alkaline power, by the sign +.

Oxygen,	— 1.0000	Azote,	— 0.7710
Nitric acid,	— 0.9406	Chlorocyanic acid,	— 0.7118
Oxygenated chloric acid,	— 0.9310	Oxide of carbon,	— 0.5752
Nitrous acid,	— 0.9303	Oxalic acid,	— 0.5741
Chloric acid,	— 0.9163	Cyanogen,	— 0.5634
Hyponitrous acid	— 0.9156	Hydrochloric acid,	— 0.5215
Deutoxide of chlorine or chlorous acid,	— 0.8936	Peroxide of hydrogen,	— 0.3562
		Carbon,	— 0.3209
Nitrous gas,	— 0.8931	Hydro-cyanic acid,	— 0.1739

Protoxide of azote gas,	— 0.8542	Acetic acid,	— 0.0364
Protoxide of chlorine or euchlorine,	— 0.8541	*Point of true neutrality,*	0.0000
		Water,	+ 0.2169
Chlorine,	— 0.8207	Ammonia,	+ 1.1209
Carbonic acid,	— 0.8148	Olefiant gas,	+ 1.1478
Phosgene gas, or chloroxicarbonic acid,	— 0.7889	Carburetted Hydrogen,	+ 2.2515
		Hydrogen,	+ 10.0222

Mem. dell. Reale Acad. Torino, tom. xxviii. p. 73.

20. *Analysis of the Sulphuret of Manganese from Transylvania, by Arfvedson.*

Manganese,	62.60
Sulphur,	37.00

The formula $\mathrm{Mn\,S^2}$, giving one atom of manganese, and two of sulphur, makes this proportion = 63.88 : 36.12. (Poggendorff's *Ann. der Phys.* 1824. 5.)

21. *Analysis of Blende, crystallized, yellow, and transparent, by Arfvedson.*

Zinc,	66.34
Sulphur,	33.66

It contained, besides, a trace of iron. The formula $Zn\,\mathrm{S}^2$, expressing one atom of zinc, and two of sulphur, agrees with the proportion 66.34 : 33.09.

22. *Analysis of Capillary Pyrites, by Arfvedson.*

Nickel,	64.35
Sulphur,	34.26

It appeared to contain traces of cobalt and arsenic. The proportion between one atom of nickel and two atoms of sulphur is 64.35 : 35.02. The sulphuret of nickel is not magnetic.

23. *Analysis of two varieties of Harmotome, by Dr Wernekingk of Giessen.*

	From Annerode.	From Schiffenberg.
Silica,	53.07	44.79
Alumina,	21.31	19.28
Lime,	6.67	1.08
Baryta,	0.39	17.59
Oxide of iron and manganese,	0.56	0.85
Water,	17.09	15.32

Both kinds occur in the cavities of basaltic hills, near Giessen, in Hessia, at a distance of about three miles from each other. (Gilbert's *Ann. der Physik.* 1824, 2. p. 171.)

24. *Analysis of Sideroschisolite, by Dr Wernekingk.*

Silica,	16.3
Black oxide of iron,	75.5
Alumina,	4.1
Water,	7.3
	103.2

Dr Wernekingk is of opinion, that this mineral is a variety of the Cronstedtite of Steinmann, at least in so far as may be inferred from the description given by Zippe of the latter mineral. He described Sideroschisolite as occurring in small simple three-sided and six-sided pyramids; the former resembling tetrahedrons, fixed to the support with their most acute solid angle or apex, and showing a perfect cleavage perpendicular to the axis, the face of crystallization parallel to it being smooth, the inclined faces often convex. These forms would be analogous to the hemi-rhombohedral ones of tourmaline and red silver ore. They are sometimes grouped with divergent axes. The hardness is between 2.0 and 3.0, (gypsum and calcareous spar); the specific gravity probably above 3.0. Before the blowpipe, it melts easily into a black magnetic globule; thin laminæ of the mineral, exposed to the flame of a candle, become iron-black and magnetic. Exposed to nitric acid, they become white and keep their form, but show a gelatinous consistency when touched.

The sideroschisolite occurs along with conchoidal magnetic pyrites and sparry iron at Conhonas do Campo, in Brazil. (Poggendorff's *Ann. der Phys.* 1824. 8. p. 387.)

25. *Analysis of Uranite by Berzelius.*

	From Autun.	From Cornwall.
Baryta - -	1.51	0.00.
Lime - - -	5.66	0.00.
Oxide of Copper - -	0.00	8.44.
Magnesia and Manganese	0.19	0.00.
Oxide of Uranium -	59.37	60.25.
Phosphoric Acid -	14.63	15.57.
Water - -	14.90	15.05.
Foreign Admixtures -	2.85	0.70.

The variety from Autun showed, besides, traces of fluoric acid and ammonia, that from Cornwall arsenic acid and fluoric acid. The chemical formulae given by Berzelius are for the varieties

From Autun - $\ddot{Ca}^3\ \overset{:\cdot:}{P}{}^2 + 4\ \dddot{U}\ \overset{:\cdot:}{P} + 48\ Aq.$

From Cornwall - $\ddot{Cu}^3\ \overset{:\cdot:}{P}{}^2 + 4\ \dddot{U}\ \overset{:\cdot:}{P} + 48\ Aq.$

They differ in their ingredients of lime and copper. Berzelius proposes to apply in future the name of *Chalcolite* to the variety from Cornwall, in order to distinguish it as a particular species from the French variety, for which he retains the name of *Uranite*. He says, " Since, according to Mitscherlich's excellent discovery, lime and oxide of copper are isomorphous bodies, they must assume the same form of crystallisation, if combined with the same number of atoms of oxide of uranium, phosphoric acid, and water, and therefore remain only one mineralogical species in the eyes of those who take no notice of any thing but the crystalline forms, which, however, cannot be allowed to be just, when viewed from the chemical side of the question." It may be added, that not only the forms, but also the rest of the characters of the two kinds of Uranite have not hitherto presented any decisive mark by which they might be distinguished with perfect security; but it must be allowed that the substances themselves are very imperfectly known. When these, particularly the variety from Autun, shall have been more accurately examined, it will be possible to say whether or not they should form separate species, for nothing can follow from the isomorphism of two bodies upon the determination of the species; since Berzelius himself, who derives the specific difference of Chalcolite and Uranite from the presence of two isomorphous bases, considers the presence of arsenic acid, in greater or smaller proportions in the Chalcolite, as unavailing, because this and the phosphoric acid are isomorphous bodies. (Poggendorff's *Ann. der Phys.* 1824. 8. p. 379.)

III. NATURAL HISTORY.

MINERALOGY.

26. *Axotomous Arsenical-pyrites, a New Mineral Species.*

Prismatic. $\mathrm{P} = 117° 28', 90° 51', 121° 58'$. Approx.

$$(\mathrm{a} : \mathrm{b} : \mathrm{c} = 1 : \sqrt{0.8747} : \sqrt{0.4806}.)$$

Simple forms. $\bar{\mathrm{P}}\mathrm{r}$ (*o*) $= 51° 20'$; $\mathrm{P} + \infty$ (*d*) $= 122° 26'$.

Combination. $\bar{\mathrm{P}}\mathrm{r}\ \mathrm{P} + \infty$. Fig. 13. *Cleavage,* $\mathrm{P} - \infty$, perfect; less distinct $\breve{\mathrm{P}}\mathrm{r} = 86° 10'$; traces of $\mathrm{P} + \infty$. *Fracture* uneven. *Surface* faintly streaked parallel to the common edges of combination, frequently smooth.

Lustre metallic. *Colour* between silver-white and steel-grey. *Streak* greyish-black.

Brittle. *Hardness* = 5.0 . . . 5.5. *Sp. Gr.* = 7.228, the massive variety from Reichenstein.

Compound varieties. Massive: composition granular, individuals small, often nearly impalpable, and strongly connected, fracture uneven; composition columnar, rather thick and irregular, and divergent. Faces of composition irregularly streaked.

Observations.—The axotomous arsenical-pyrites contains arsenic and iron, in proportions which have not yet been ascertained. It occurs in a bed of sparry iron, at Löling, near Hüttenberg, in Carinthia, along with octahedral bismuth and skorodite, and was distinguished by Professor Mohs from the other more common species of arsenical-pyrites. The same species he found afterwards among the cobalt ores from Schladming, in Stiria, and imbedded in the serpentine from Reichenstein, in Silesia. In the latter place it seems to occur in very considerable quantities. The crystals have been observed among the varieties from Schladming. (Mohs, vol. ii. p. 522. *Transl.* vol. ii. p. 448.)

27. *Prismatoidal Copper-Glance, a New Mineral Species.*

Prismatic. Combination. 1. $\breve{\mathrm{P}}\mathrm{r}$ (*P*) $\mathrm{P} + \infty$. (*M*) $\breve{\mathrm{P}}\mathrm{r} + \infty''$ (*h*). Sim. Fig. 11. *Cleavage,* $\breve{\mathrm{P}}\mathrm{r} + \infty$ rather perfect, though interrupted. *Fracture* imperfect conchoidal. *Surface* rough. *Lustre* metallic. *Colour* blackish lead-grey. *Streak* unchanged. *Brittle.* *Hardness* = 3.0. *Sp. Gr.* = 5.735.

Compound Varieties. Massive: composition granular, individuals strongly connected.

Observations.—The prismatoidal Copper-glance has been hitherto found only in the beds of sparry-iron at St Gertraud, near Wolfsberg, in the valley of Lavant, in Carinthia. It is very nearly allied to the following species. It will depend upon future accurate examinations, particularly of its regular forms, whether or not the varieties of the two species are identical. This species was determined by Professor Mohs, before he was acquainted with any of the varieties of the Bournonite. Though it is likely that they do not present any specific difference, it would be too precipitate to unite them, without being capable of affording a demonstration of their identity.

Before the blow-pipe, the two species give very nearly the same results. They both contain sulphur, antimony, lead, and copper; but the prismatoidal copper-glance yields also a little silver, for the extraction of which it is collected by the miners, without, however, properly speaking, being an object of mining. (Mohs, vol. ii. p. 559; *Transl.* vol. iii. p. 4.)

28. *Axotomous Antimony-Glance, a New Mineral Species.*

Prismatic. Simple forms. $P + \infty = 101^\circ\ 20'$ (nearly); $\breve{P}r + \infty$. Combinations, of the preceding forms, their terminations not observed. *Cleavage*, $P - \infty$ highly perfect; less distinct, though easily observed, when the crystals are not too small, the prism $P + \infty$, and $\breve{P}r + \infty$ the plane parallel to the short diagonal. *Fracture* not observable. *Surface* deeply streaked, parallel to the axis of the prisms. *Lustre* metallic. *Colour* steel-gray. *Streak unchanged. Sectile. Hardness* = 2.0 ... 2.5 *Sp. Gr.* = 5·564.

Compound Varieties. Massive: composition columnar, individuals generally very delicate; straight and parallel, or divergent.

Observations.—Nothing as yet is known of the proportions among the ingredients of the present species. It contains sulphur, antimony, and lead. The axotomous Antimony-glance seems to be a rare mineral, or at least not sufficiently attended to by mineralogists. It occurs in masses of considerable dimensions in Cornwall, sometimes along with the diprismatic Copper-glance, as in Huelboys. In Hungary it is engaged in rhombohedral Limehaloide, but its locality is not exactly known.—(*Mohs,* vol. ii, p. 586. *Transl.* vol. iii. p. 26.) Mr Haidinger proposes for this species the name of *Jamesonite,* in honour of Professor Jameson, who has so much contributed to the present general diffusion of mineralogical knowledge.

29. *Hemiprismatic Ruby-Blende, a new Mineral Species.*

Hemiprismatic. Fundamental form. Scalene four-sided pyramid. $P = \left\{ \begin{matrix} 128^\circ\ 59' \\ 121^\circ\ \ 1' \end{matrix} \right\}$, $130^\circ\ 7'$, $77^\circ\ 16'$. Inclination of the axis $= 11^\circ\ 6'$, in the plane of the long diagonal. Approx. ($a : b : c : d = 5.1 : 9.5 : 8.7 : 1.$)

Combinations. 1. $P - \infty$ (*b*). $\frac{\breve{P}r + 1}{2}$ (*r*). $P + \infty$ (*f*). Fig. 14.

$2.\ P - \infty.\ \frac{\frac{3}{4}\breve{P}r + 2}{2}\ (g).\ - \frac{\breve{P}r + 1}{2}.\ P + \infty.$ Fig. 15. Inclination of *f* on *f* = 86° 4′; of *b* on edge *x* = 101° 6′; of *g* on the same = 151° 51′; of *t* on the same 132° 34′. . There occur many secondary faces; the whole has much the appearance of crystals of hemiprismatic Vitriol-salt.

Cleavage, parallel to *g*, and to a face replacing the edge x of the prism, imperfect. *Fracture* imperfect conchoidal. *Surface*, deeply streaked parallel to the edges of combination with *y*, particularly *b* and *f*, as indicated in the figure; the pyramids are smooth, *t* rough, though even. *Lustre* intermediate between metallic and metallic adamantine. *Colour* iron-black. *Streak* dark cherry-red. *Opake*, except in thin splinters, where it transmits a deep blood-red colour. *Very sectile*. *Hardness* = 2.0 ... 2.5. *Sp. Gr.* = 5.2 ... 5.4.

Observations.—The chemical composition of this species, one of those which were formerly comprised under the dark-red silver, has not been as yet exactly ascertained. Before the blow-pipe, it gives results nearly agreeing with those of rhombohedral Ruby-blende, but it contains only about 35.00 ... 40.00 per cent. of silver, besides sulphur and antimony. The only specimen of it, in the possession of Mr Von Weissenbach at Freiberg, is supposed to have been found in the mine called Neue Hoffnung Gottes, at Bräunsdorf, near Freiberg, in Saxony. It consists only of crystals, and is not accompanied by any other mineral.

A finely crystallised specimen from Hungary is in the possession of Mr Brooke, which seems to have some properties analogous to the hemiprismatic Ruby-blende. Yet its combinations appear to be tetartoprismatic, and may therefore belong to another species. (Mohs, vol. ii. p. 606. *Transl.* vol. iii. p. 42.) Professor Mohs remarks, in regard to the light and dark-coloured varieties of Red Silver, that the difference between these varieties, though originally founded on the different tints of colour and streak of the two minerals, and on their lustre, which is dependent upon them, is deeper rooted in the essence of these bodies than it would appear at first sight. Though the forms do not seem to be very different, and the peculiarities in the series of crystallizations be common to both, the specific gravity of the two substances is considerably different, being circumscribed, as far as our present information goes, within the limits of 5.8 ... 5.9 for the dark-red, and of 5.4 ... 5.6 for the light-red variety. A dark-red cleavable variety from the Hartz gave 5.831, a light-red one, also cleavable, from Annaberg, 5.524, and a crystallised one from the Churprinz mine, near Freiberg, having the colour of the dark-red variety, 5.422. This subject deserves the particular attention of mineralogists, though as yet it is impossible to settle any thing in regard to the determination of the species.

30. *Fergusonite, a New Mineral Species.*

Hemipyramidal, with parallel faces. P = 100° 28′, 128° 27′ Approx. ($a = \sqrt{4.5}$.)

Combination. $\mathrm{P} - \infty\ (i).\ \mathrm{P}\ (s).\ \frac{(\mathrm{P}-1)^5}{2}(z).\ \frac{[(\mathrm{P}+\infty)^5]}{2}(r).$ Fig. 17. Inclination of z on $z' = 159° 2'$.

Cleavage, traces parallel to P. *Fracture* perfect conchoidal. *Surface* rather uneven. *Lustre* imperfect metallic, inclining to resinous. *Colour* dark brownish-black, in thin splinters pale. *Streak* very pale brown, like peritomous titanium-ore. *Opake,* in thin splinters *translucent.* *Brittle.* *Hardness* = 5.5 ... 6.0. *Sp. Gr.* = 5.838, Allan; = 5.800, Turner. *Not magnetic.*

Observations.—Before the blow-pipe, it loses its colour, and becomes pale greenish-yellow, but is alone infusible. It is entirely dissolved in salt of phosphorus, but some particles remain a long time unaltered. The pale greenish globule becomes opake by flaming, or on cooling, when very much saturated. Before the whole portion has been dissolved, it assumes a pale rose colour in the reducing flame. It has been considered as an Yttro-tantalite, which is not contradicted by the experiments before the blow-pipe. It is described under that denomination in the German *Grundriss* of Mohs. Mr Haidinger has given it the name of Fergusonite, at the suggestion of Mr Allan, in compliment to Robert Ferguson, Esq. of Raith.

It was discovered by Sir Charles Giesecke, imbedded in rhombohedral Quartz at Kikertaursak, near Cape Farewell, in Greenland. The specimens to which the preceding description refers are in the cabinet of Mr Allan. Crystals of it had been described by Mr Phillips, and examined before the blow-pipe by Mr Children, under the name of Allanite; from which, however, it is sufficiently distinguished by the tetartoprismatic form of the latter.—(Mohs, vol. ii. p. 688. *Transl.* vol. iii. p. 98. *Trans. Roy. Soc. Edinb.* vol. x. part 2, p. 271.)

31. *Picrosmine, a New Mineral Species.*

Prismatic. P = 151° 3′, 120° 0′, 67° 59′. Approx. ($a : b : c = 1 : \sqrt{11.00} : \sqrt{2.75}$.)

Simple forms and combinations not known; the character of the latter prismatic, as it appears from cleavage. *Cleavage,* $\breve{\mathrm{P}}\mathrm{r} + \infty\ (M)$ perfect; $\bar{\mathrm{P}}\mathrm{r} + \infty\ (T)$ less, $\bar{\mathrm{P}}\mathrm{r}\ (i) = 117° 49'$ still less distinct. Least of all $\mathrm{P} + \infty\ (s) = 126° 52'$. The product of all the faces of cleavage is represented by Fig. 16. *Fracture* uneven, scarcely perceptible. *Lustre* pearly, distinct upon $\breve{\mathrm{P}}\mathrm{r} + \infty$, inclining to vitreous upon the other faces. *Colour* greenish-white, passing into greenish-grey and mountain-green, sometimes also oil-, leek-, and blackish-green. *Streak* white, dull. *Translucent* on the edges ... *opaque.* *Very sectile.* *Hardness* = 2·5 ... 3·0. *Sp. Gr.* = 2·660 of a cleavable compound variety, 2·596 of a columnar variety.

Compound Varieties. Massive: composition granular, strongly coherent. If the composition becomes impalpable, the fracture is earthy. The particles of columnar compositions are very thin; fracture splintery.

Observations. Its chemical composition is unknown. Before the blow-pipe it is infusible, but gives out water, becomes first black, then white and opaque, and acquires a degree of hardness nearly = 5·0. It is soluble in salt of phosphorus, with the exception of a silica skeleton. When heated with solution of cobalt, it assumes a pale red colour, even when fused, and appears therefore to contain water, silica, and magnesia.

The cleavable varieties have been found, accompanied by octahedral Iron-ore and macrotypous Lime-haloide, in a bed in primitive rocks. The only locality hitherto known is the iron mine called Engelsburg near Presnitz in Bohemia.

It is likely that many varieties of the common Asbestus of Werner, (JAM. Syst. vol. ii. p. 156,) particularly that from Zöblitz in Saxony, should be referred to this species. According to Wiegleb, it consists of silica, 46.66; magnesia, 48.45; oxide of iron, 4.79.

Various localities are quoted for the common Asbestus; but since Asbestus contains also varieties of pyroxene and amphibole, they cannot all be supposed exact, and it would, therefore, be very interesting to institute a closer natural-historical examination of all these minerals. Among the localities chiefly quoted are Zöblitz in Saxony, Silesia, the Tyrol, and many other countries along the line of the Alps, the Shetland isles, Portsoy, &c., where it occurs in veins traversing serpentine, in the Taberg and other places in Sweden, where it occurs in beds, along with octahedral Iron-ore, with several species of Pyrites, rhombohedral and macrotypous Lime-haloide, &c.

Picrosmine was proposed as a species of its own by Mr Haidinger, who has been indebted for the specimens which he examined to Mr Lingke, mathematical and philosophical instrument maker at Freiberg. The trivial name is derived from πικρὸς, bitter, and ὀσμὴ, odour, from the bitter and argillaceous odour the mineral exhales when wetted.—(Mohs, vol. ii. p. 672. *Transl.* p. 137.)

32. *Brookite, a New Mineral Species.*

Prismatic. P = 135° 46′, 101° 37′, 94° 44′

$$(a : b : c = 1 : \sqrt{3.237} : \sqrt{1.149}.)$$

Combination. 1. $\breve{P}r. - 1$ (a^2). $\breve{P}r$ (a^1). $(\frac{4}{3}\,\breve{P} - 2)^3$ (i). $(\breve{P}r - 1)^3$ ($b\frac{1}{2}$). $\frac{4}{3}\,P\bar{r}$ ($e\frac{3}{8}$). P (e^3). $(\breve{P}r + \infty)^3$ (m). $\breve{P}r + \infty$ (h^1). $Pr + \infty$ (g^1). From Snowdon. Fig. 18.

Inclination of a^2 on a^2 = 148° 56′; of a' on a' = 124° 52′; of m on m = 100° 0′; of i on i, over a', = 149° 37′; of 6½ on 6½, over a, = 135° 41′.

Lustre metallic adamantine. *Colour* hair-brown, passing into a deep orange-yellow, and some reddish tints. *Streak* yellowish-white. *Translucent* ... *opake*, the brighter colours are observed by transmitted light.

Brittle. *Hardness* = 5.5 ... 6.0.

It contains titanium, but has not yet been analysed. This beautiful substance has been described as a particular species by Mr Lévy, and named in honour of Mr Brooke. The first varieties had been noticed by Mr Soret among the minerals accompanying pyramidal Titanium-ore from Dauphiny; but much finer crystals, some of them half an inch in diameter, have lately been found at Snowdon in Wales. In both places they are accompanied by rhombohedral Quartz, in Dauphiny, besides pyramidal Titanium-ore, also by Crichtonite and Albite.—*Ann.* of Phil. Feb. 1825.

BOTANY.

33. *On the Nature of Galls.*—In a memoir that M. Virey has inserted in the *Journal de Pharmacie*, for July 1823, he states, that with a view to ascertain the internal structure of the vegetable excrescences commonly called Galls, he has subjected to a microscopical investigation the spongy interior of the great galls of the Tozin oak, *(Quercus Toza,)* those of the corn Saw-wort, *(Serratula arvensis,)* and the central portion of the galls upon the rose-bush, (vulgarly called in England *Robin Redbreast's pincushions.)* The conclusion at which M. Virey has arrived is, that these substances do not consist of vegetable fibres, properly so called, but that the swelling of the cellular tissue of the plants is occasioned by the irritation produced by the acrid venom of the *Cynips* which there deposits its eggs: that this irritation is analogous to that excited in the cellular tissue of animals by the prick of a thorn; finally, that the gallic acid and the tannin of galls are contained in tubular vesicles. These two principles, the abundance of which constitutes the excellence of the best gall-nuts, are evident under the form of an opaque, brown, and grumous matter.

ZOOLOGY.

34. *Physalia Arethusa.*—Dr Eichwald has published some very interesting observations on this species. The body is an oblong bag, the upper part of which is attenuated, and contains an aperture. This bag is thicker, and less transparent than an inner one, with the walls of which it is in contact at the sides, but not at the extremities, unless at the aperture. The *branchiæ* constitute a crust on the right side, of complicated organization. The inner bag is supplied with secreted air, by which the body is enabled to rise to the surface of the water. The cavity in the interior of the outer bag, opposite the aperture, is plicated, and exhibits many openings, the termination of the canals of those organs with which the inferior disc of the body is covered. These our author divides into two kinds. The *tubuli auctorii*, terminate in an expanded disc or sucker, and are considered as organs of nutrition. The *funiculi proliferi*, are longer, narrower, more complicated, and considered as subservient to the reproductive system, according to the gemmiparous mode. They probably likewise serve as prehensile organs.—See *Mém. de l'Acad. Imp. des Scien. de St Petersbourg.* t. ix. 453. Tab. xv. (F.)

GENERAL SCIENCE.

35. *Hatching of Fish.*—The Chinese have a method of hatching the spawn of fish, and thus protecting it from those accidents which generally destroy a large portion of it. The fishermen collect with care, on the margin and surface of water, all those gelatinous masses which contain the spawn of fish; and after they have found a sufficient quantity, they fill with it the shell of a fresh hen's egg, which they have previously emptied. stop up the hole, and put it under a sitting fowl. At the expiration of

a certain number of days, they break the shell in water warmed by the sun. The young fry are presently hatched, and are kept in pure fresh water till they are large enough to be thrown into the pond with the old fish. The sale of spawn for this purpose, forms an important branch of trade in China.—Professor Silliman's *Journal of Science,* Vol. VIII. p. 381.

36. *Mr Lizars' Work on the Removal of Ovaria.*—We are glad to see that Mr Lizars, surgeon, author of the System of Anatomical Plates, has announced an account of his successful operations for the removal of enlarged *Ovaria.* In one of these cases, the abdominal cavity was laid open, and an ovarium extracted which measures eleven inches long, by seven and a half broad, and weighs upwards of five pounds. The work is to be accompanied with four Plates, demy folio size, coloured after nature; the 1st showing the situation and appearance of the viscera, and enlarged ovarium, during the operation. 2d, The extent and appearance of the wound when healed. 3d, Front view of the ovarium, the natural size. 4th, Lateral view of the ovarium, the natural size.

37. *Mr Bate's Essay on Spectacles.*—This little work, addressed "*To all who value their Sight,*" and entitled "A few Practical Suggestions and Illustrations, intended simply to awaken the attention of every individual to the condition of his eyes, and enable him to promote the improvement and preservation of that invaluable faculty," has just been published by Mr R. B. Bate, optician, Poultry, London, whose professional eminence and acquirements are well known. The treatise is written with great perspicuity and plainness, and is well worthy the perusal of all classes.

38. *Mr Innes's Tide Tables for* 1825.—Mr Innes, whose talents as an astronomical calculator are well known to the readers of this Journal, has published (in November 1824) his "Aberdeen, Leith, and London Tide Tables for 1825, with various other useful tables, and a list of vessels registered at the port of Aberdeen." This little work has all the advantages of an almanack, and will be found of great use to commercial readers.

39. *The Emperor of Russia's Present to Professor Barlow.*—His Majesty the Emperor of Russia has presented Professor Barlow, of the Royal Military Academy, through his Excellency Count Lieven, with a gold watch and rich dress chain, as a mark of the value which his Majesty places on the magnetic discoveries of that gentleman, and their important application to the science of navigation.

ART. XXXVI.—LIST OF PATENTS FOR NEW INVENTIONS, SEALED IN ENGLAND SINCE JULY 27, 1824.

July 27. For Improvements in *Power Looms, and Preparation of Warps.* To T. W. STANSFELD, Leeds.

July 27. For *Improved Roller Printing-Presses.* To E. Cartwright, London.

July 29. For a *New Swift for Winding Silk, &c.* To C. Jefferies and E. Drake, Congleton.

July 29. For a *Method of Improving the Tones of Piano Fortes, Organs, &c.* To W. Wheatstone, London.

Aug. 5. For Improvements on *Spinning Machines.* To John Price, Stroud.

Aug. 5. For a New Mariner's *Compass.* To George Graydon, Bath.

Aug. 5. For a *Method of Evaporating Fluids,* for conveying Heat, &c. To W. Johnson, Great Totham.

Aug. 9. For Improvements in *Propelling Vessels.* To Jacob Perkins, London.

Aug. 11. For an Improved Method of *Heating Woollen Cloths.* To John Fussell, Mells.

Aug. 11. For a New *Filter.* To Herman Schroder.

Aug. 28. For a Method of *Producing Intense Cold.* To John Vallance, Brighton. See this vol. p. 148.

Sept. 6. For Improved Methods of *Propelling Ships.* To James Nivell and W. Busk, London.

Oct. 1. For an Improved Method of *Casting Steel.* To H. W. Needham, London.

Oct. 1. For Improved *Steam-Engines.* To W. Foreman, Bath.

Oct. 7. For Improved Methods of *Preparing Spelter* or Zinc. To F. Benecke, D. Towers Spears, and J. H. Spears, London.

Oct. 7. For an Improved Method of *Generating Steam.* To P. Alegre.

Oct. 7. For an Improved *Flue* for Furnaces, &c. To H. Jefferys, Bristol. See this vol. p. 342.

Oct. 7. For Improved *Metal Casks or Barrels.* To R. Dickinson, London.

Oct. 7. For Improved *Fire Escapes.* To Francis Richman, London.

Oct. 7. For Machinery for *Making Velvet, &c.* To S. Wilson, Streatham.

Oct. 7. For an Improved Process for *Making Vinegar.* To John Ham, West Coke.

Oct. 7. For Improved Machinery for *Printing Calicoes, &c.* To Matthew Bush, Westham.

Oct. 7. For *Transverse Spring Slides* for Trumpets, &c. To John Shaw, Milltown.

Oct. 7. For Improved *Shoes for Horses, &c.* To J. T. Hodgson, Lambeth.

Oct. 14. For Improved *Machinery for Spinning Flax, &c.* To Phillip Chell, London.

Oct. 14. For Improved *Machinery for Spinning Cotton and Wool.* To J. G. Bodnier, Manchester.

Oct. 14 For Improvements on *Wheeled Carriages.* To James Gun, London.

ART. XXXVII.—LIST OF PATENTS GRANTED IN SCOTLAND SINCE NOVEMBER 30, 1824.

30. Dec. 16. For *Elastic Stoppers*, for Stopping, Releasing, and Regulating Chains and other Cables. To T. R. BOWMAN, Aberdeen.

31. Dec. 30. For Improved *Looms, &c.* To P. J. B. VICTOR GOSSET, London.

32. Dec. 30. For Improved *Looms*. To JOHN POTTER, Smidley.

1. Jan. 1, 1825. For Improved *Portable Gas Lamps*. To DAVID GORDON, London.

2. Jan. 17. For Improvements in *Steam-Engines*. To W. FOREMAN, Bath.

3. Jan. 17. For Improved *Looms, &c.* To T. W. STANSFELD, Leeds.

4. For Improved *Ship's Tackle*. To W. S. BURNETT, London.

5. Feb. 9. For Improved *Carriages, &c.* To DAVID GORDON, London.

6. Feb. 10. For Improvements in *Propelling Vessels*. To Lieut. W. H. HILL, Royal Artillery.

7. Feb. 14. For Improved *Paper Machinery*. To J. and C. PHIPPS.

8. Feb. 21. For Diaphane Stuffs, communicated by a Foreigner. To S. WILSON, Streatham.

9. Feb. 22. For a New *Method of Applying Heat*. To J. SURREY, Battersea.

10. March 5. For Improvements in the *Manufacture of Silk, &c.* To R. BADNALL, Leek.

11. March 7. For an Apparatus for *Bottling Liquids*. To THOMAS MASTERMAN, London.

12. March 7. For an Improved Method of *Corking Bottles*. To JOHN MASTERMAN, London.

ART. XXXVIII.—CELESTIAL PHENOMENA,

From April 1, to July 1, 1825, calculated for the Meridian of Edinburgh. By Mr GEORGE INNES, Aberdeen. Communicated by the Author.

These calculations are made for Astronomical time, the day beginning at noon. The Conjunctions of the Moon and Stars are given in Right Ascension.

APRIL.

D.	H.	M.	S.	
1	7	22	—	☌ ☿ ζ ♓
1	18	27	20	☌ ♂ ο ♓
2	18	13	39	○ Full Moon.
3	9	18	49	☌ ☽ ι ♍
3	11	4	18	Em. I. Sat. ♃
4	18	17	—	☌ ♀ η ♉
5	12	11	54	Em. II. Sat. ♃
5	22	26	25	☌ ☽ δ ♏
7	8	51	0	☌ ☽ B Oph.
7	10	10	—	☌ ☿ ♂
9	2	51	31	☌ ☽ ο ♐

D.	H.	M.	S.	
9	5	19	40	☌ ☽ π ♐
9	16	17	28	☌ ☽ ♅
9	16	57	15	☾ Last Quarter.
10	12	59	11	Em. I. Sat. ♃
12	7	27	56	Em. I. Sat. ♃
17	21	7	24	● New Moon.
18	17	1	30	☌ ☽ ♂
18	17	55	—	☌ ☿ δ ♈
19	9	22	54	Em. I. Sat. ♃
19	13	47	37	☌ ☽ δ ♈
19	15	37	32	☌ ☽ ☿
19	21	35	47	☉ enters ♉
20	13	54	27	☌ ☽ A ♉
20	15	36	28	☌ ☽ ε ♉
20	22	27	12	☌ ☽ ♀
20	23	6	38	☌ ☽ 2 κ ♉
20	23	26	34	☌ ☽ ♄
22				☿ Greatest Elong.
22	22	21	7	☌ ☽ 132 ♉
22	22	23	30	☌ ☽ η II.
23	1	50	50	☌ ☽ μ II.
23	18	42	5	☌ ☽ ζ II.
25	10	55	5	☌ ☽ ♃
25	12	13	10	☽ First Quarter.
26	11	17	54	Em. I. Sat. ♃
26	12	45	28	☌ ☽ ξ ♌
26	16	53	26	☌ ☽ o ♌
27	1	26	55	☌ ☽ π ♌
30	9	20	34	Em. II. Sat. ♃
30	19	51	27	☌ ☽ ι ♍

MAY.

D.	H.	M.	S.	
1	13	19	14	☌ ♄ a ♉
2	2	43	35	○ Full Moon.
3	8	52	19	☌ ☽ δ ♏
4	18	35	0	☌ ☽ B Oph.
6	11	38	10	☌ ☽ o ♐
6	11	40	28	Em. III. Sat. ♃
6	13	49	46	☌ ☽ π ♐
6	17	21	11	☌ ☽ d ♐
7	0	57	55	☌ ☽ ♅
7	11	57	32	Em. II. Sat. ♃
9	9	4	27	☾ Last Quarter.
11	4	45	—	☌ ☿ ♂ near contact.
12	6	45	—	☌ ♃ δ ♋
12	9	36	41	Em. I. Sat. ♃
13	17	45	—	Inf. ☌ ☉ ☿
14	19	55	52	☌ ☽ η ♓
16	20	24	40	☌ ☽ δ ♈
17	0	56	38	☌ ☽ ☿
17	11	49	27	● New Moon.
17	16	36	—	☌ ☽ ♀
17	16	55	20	☌ ☽ ♂
17	25	0	16	☌ ☽ A ♉
18	5	20	0	☌ ☽ κ ♉
18	12	3	9	☌ ☽ ♄
19	4	4	54	Inf. ☌ ☉ ♀
20	4	2	55	☌ ☽ η II.
20	7	27	16	☌ ☽ μ II.
20	21	56	30	☉ enters II.
21	1	2	13	☌ ☽ ζ II.
22	22	4	5	☌ ☽ ♃
23	3	21	15	☌ ☽ 2a ♋
24	7	29	50	☌ ☽ π ♌
24	18	35	5	☽ First Quarter.
26	10	5	12	☌ ☉ ♂
28	4	29	13	☌ ☽ ι ♍
29	9	44	50	☌ ♂ a ♉
30	18	39	53	☌ ☽ δ ♏
31	11	42	34	○ Full Moon.

JUNE.

D.	H.	M.	S.	
1	4	28	0	☌ ☽ B Oph.
1	17	12	7	☌ ☉ ♄
2	21	3	12	☌ ☽ o ♐
2	23	16	50	☌ ☽ π ♐
3	2	45	24	☌ ☽ d ♐
3	8	56	52	☌ ☽ ♅
4	7	41	12	☌ ☽ β ♑
4	9	50	33	Em. I. Sat. ♃
8	2	3	1	☾ Last Quarter.
10				☿ Greatest Elong.
11	3	44	45	☌ ☽ η ♓
13	7	21	24	☌ ☽ ♀
14	3	2	—	☌ ☽ ☿
14	3	58	43	☌ ☽ A ♉
14	12	58	23	☌ ☽ 2 κ ♉
15	2	14	15	☌ ☽ ♄
15	13	37	14	☌ ☽ ♂
16	0	9	58	● New Moon.
16	14	25	13	☌ ☽ μ II.
17	7	41	5	☌ ☽ ζ II.
18	0	35	40	☌ ☿ ε ♉
19	1	10	53	☌ ☿ a ♉
19	9	7	30	☌ ☽ 2 a ♋
19	11	30	53	☌ ☽ ♃
20	4	15	36	☌ ☽ o ♌
20	12	56	53	☌ ☽ π ♌

D.	H.	M.	S.		D.	H.	M.	S.	
21	6	36	58	☉ enters ♋	28	13	0	0	☌ ☽ B Oph.
22	23	3	35	☽ First Quarter.	29	21	55	9	Full Moon.
23	5	26	18	☌ ☿ ♄	30	5	57	11	☌ ☽ ο ♐
24	5	7	30	☌ ♂ 132 ♉	30	8	11	23	☌ ☽ π ♐
24	10	49	22	☌ ☽ ι ♍	30	11	43	56	☌ ☽ d ♐
27	2	23	50	☌ ☽ σ ♏	30	16	10	32	☌ ☽ ♅

On the 31st of May there will be a very small Eclipse of the Moon, which will be visible.

	D.	H.	M.	S.
The eclipse begins May, - - -	31	11	38	22
Ecliptic opposition, - - - -		11	42	35
Middle, - - - - -		11	53	7
End of the eclipse, - - - -		12	7	51

Digits eclipsed, 0° 12′ 25″, by the south side of the earth's shadow, or on the north part of the moon's disc.

Times of the Planets passing the Meridian.

APRIL.

	Mercury.		Venus.		Mars.		Jupiter.		Saturn.		Georgian.	
D.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
1.	0	25	2	49	0	57	7	45	3	31	18	45
5.	0	39	2	44	0	52	7	30	3	17	18	30
10.	0	55	2	29	0	45	7	10	2	59	18	10
15.	1	8	2	28	0	40	6	52	2	41	17	50
20.	1	14	2	16	0	34	6	34	2	24	17	31
25.	1	13	2	1	0	29	6	15	2	7	17	11

MAY.

	Mercury.		Venus.		Mars.		Jupiter.		Saturn.		Georgian.	
D.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
1.	1	1	1	37	0	23	5	53	1	40	16	47
5.	0	45	1	17	0	19	5	40	1	33	16	31
10.	0	19	0	50	0	13	5	21	1	15	16	11
15.	23	45	0	18	0	8	5	4	0	59	15	51
20.	23	16	23	42	0	3	4	48	0	42	15	31
25	22	53	23	13	23	58	4	31	0	25	15	12

JUNE.

	Mercury.		Venus.		Mars.		Jupiter.		Saturn.		Georgian.	
D.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.	H.	M.
1.	22	31	22	33	23	49	4	7	0	0	14	42
5.	22	26	22	15	23	46	3	57	23	45	14	26
10.	22	24	21	56	23	42	3	38	23	27	14	6
15.	22	28	21	40	23	36	3	22	23	10	13	46
20.	22	51	21	27	23	31	3	7	22	53	13	25
25.	22	54	21	16	23	28	2	50	22	36	13	5

ART. XXXIX.—REGISTER OF THE BAROMETER, THERMOMETER, AND RAIN-GAGE, *kept at Canaan Cottage.* By ALEX. ADIE, Esq. F. R. S. Edin.

The Observations contained in the following Register were made at Canaan Cottage, the residence of Mr Adie, by means of very nice instruments, constructed by himself. Canaan Cottage is situated about 1½ mile to the south of Edinburgh Castle, about 3 miles from the sea at Leith, and about ¼ of a mile N of the west end of Blackford Hill. The ridge of Braid Hills is about 1 mile to the south, and the Pentland Hills about 4 miles to the west of south. The height of the thermometer is about 260 feet above the level of the sea. The morning and evening observations were made about 10 A.M. and 10 P.M.

DECEMBER 1824.

D. of Week.	Day of Month.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.	
W.	1	31	32	31.5	28	32	30	28.83	28.94	
T.	2	34	26	30	30	35	32.5	29.10	28.97	
F.	3	31	32	31.5	22	35	28.5	29.15	29.34	
S.	4	31	19	25	25	32	28.5	29.41	29.39	
S.	5	22	38	30	16	29	22.5	29.49	29.38	.28
M.	6	44	35	39.5	36	44	40	28.97	28.84	.07
T.	7	36	34	35	33	39	36	28.97	29.35	.06
W.	8	39	38	38.5	31	42	36.5	29.37	29.31	
T.	9	36	31	33.5	34	41	37.5	29.28	29.43	
F.	10	34	43	38.5	29	39	34	29.68	29.60	
S.	11	47	50	48.5	40	50	45	29.66	29.57	
S.	12	45	50	47.5	45	52	48.5	29.85	29.85	
M.	13	51	48	49.5	49	52	50.5	29.87	30.05	
T.	14	50	47	48.5	44	50	47	30.00	29.75	
W.	15	49	37	43	45	51	48	29.47	29.51	
T.	16	38	37	37.5	36	48	42	29.58	29.59	
F.	17	37	34	35.5	34	40	37	29.69	29.82	
S.	18	45	50	47.5	31	52	41.5	29.65	29.59	
S.	19	51	42	46.5	49	51	50	29.50	29.35	.10
M.	20	34	36	35	32	48	40	28.93	29.03	.49
T.	21	36	36	36	33	38	35.5	28.89	28.88	.14
W.	22	34	31	32.5	33	37	35	28.62	29.32	.63
T.	23	28	39	33.5	25	35	30	29.58	29.20	
F.	24	38	42	40	35	40	37.5	29.14	29.08	
S.	25	51	36	43.5	36	51	43.5	28.75	28.82	.65
S.	26	34	36	35	32	37	34.5	29.15	29.57	.05
M.	27	48	41	44.5	32	52	42	28.93	29.22	.57
T.	28	38	34	36	37	40	38.5	29.30	29.65	
W.	29	37	42	39.5	33	39	36	29.73	29.20	.41
T.	30	38	45	41.5	36	45	40.5	29.58	29.55	.09
F.	31	49	43	46	37	48	42.5	29.25	29.31	.38
	Sum,	1216	1184	1200	1058	1324	1191	909.37	911.16	3.68
	Mean,	39.23	38.19	38.71	34.13	42.71	38.42	29.334	29.392	

JANUARY 1825.

D. of Week.	D. of Mon.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean.	Morn.	Even.	
S.	1	42	42	42	40	50	45	29.58	29.03	.38
S.	2	39	36	37.5	36	46	41	29.25	29.73	
M.	3	40	50	45	35	50	42.5	29.75	29.31	.21
T.	4	35	30	32.5	34	36	35	29.88	30.28	
W.	5	27	30	28.5	23	31	27	30.41	30.30	
T.	6	41	45	43	23	45	34	30.23	30.14	
F.	7	46	36	41	41	49	45	30.07	30.45	
S.	8	39	40	39.5	33	44	38.5	30.50	30.60	
S.	9	38	35	36.5	35	40	37.5	30.67	30.63	
M.	10	35	41	38	27	40	33.5	30.60	30.50	
T	11	43	39	41	37	45	41	30.52	30.43	
W.	12	40	37	38.5	36	43	39.5	30.40	30.23	
T.	13	43	43	43	36	44	40	30.13	30.00	
F.	14	45	44	44.5	39	47	43	29.93	29.70	
S.	15	45	46	45.5	43	49	46	29.55	29.38	.07
S.	16	46	38	42	43	47	45	29.08	29.20	.32
M.	17	38	42	40	34	40	37	29.43	29.13	
T.	18	41	35	38	37	45	41	28.58	28.81	
W.	19	37	37	37	31	40	35.5	28.92	29.16	
T.	20	40	39	39.5	34	41	37.5	29.37	29.72	.06
F.	21	38	38	38	36	40	38	29.80	29.81	
S.	22	36	31	33.5	31	40	35.5	29.98	30.08	
S.	23	38	37	37.5	27	40	33.5	30.07	29.95	.12
M.	24	36	35	35.5	32	39	35.5	29.65	29.28	
T.	25	33	32	32.5	30	35	32.5	29.41	29.56	.04
W	26	38	50	44	30	42	36	29.40	29.38	.06
T.	27	52	36	44	42	53	47.5	29.32	29.90	
F.	28	38	39	38.5	33	42	37.5	30.30	30.33	
S.	29	38	47	42.5	36	47	41.5	29.23	29.86	
S.	30	50	41	45.5	46	51	48.5	29.82	30.03	.05
M.	31	42	48	45	36	47	41.5	30.12	29.65	
		1239	1219	1229	1076	1348	1212	924.03	924.51	1.31
		39.97	39.32	39.64	34.71	43.48	39.10	29.806	29.823	

FEBRUARY 1825.

D. of Week.	D. of Mon.	Thermometer.			Register Therm.			Barometer.		Rain.
		Morn.	Even.	Mean.	Min.	Max.	Mean	Morn.	Even.	
T.	1	38	32	35	35	49	42	29.90	29.96	
W.	2	40	42	41	31	45	38	29.60	28.88	.30
T.	3	33	25	29	27	36	31.5	28.98	29.16	
F.	4	29	25	27	23	31	27	29.28	29.28	
S.	5	29	32	30.5	22	38	30	29.50	29.65	
S.	6	33	35	34	27	38	32.5	29.93	29.85	
M.	7	40	37	38.5	29	42	35.5	29.58	29.57	
T.	8	40	39	39.5	34	42	38	29.48	29.82	
W.	9	43	43	43	34	45	39.5	29.87	29.95	.04
T.	10	48	47	47.5	43	50	46.5	30.05	30.15	
F.	11	45	46	45.5	42	49	45.5	30.12	30.15	
S.	12	50	45	47.5	44	52	48	30.20	30.26	
S.	13	49	44	46.5	43	50	46.5	30.27	30.22	
M	14	43	34	38.5	40	44	42	30.17	29.90	
T.	15	43	44	43.5	30	46	38	29.76	29.62	
W.	16	43	38	40.5	38	45	41.5	29.66	29.50	
T.	17	46	38	42	31	50	40.5	29.42	29.65	
F.	18	42	40	41	31	48	39.5	29.85	29.99	
S.	19	40	42	41	30	49	39.5	29.97	29.78	
S.	20	42	40	41	39	48	43.5	29.92	30.12	
M.	21	40	40	40	31	48	39.5	30.20	30.21	
T.	22	43	43	43	35	50	42.5	30.18	30.03	
W.	23	42	38	40	32	48	40	29.93	29.95	
T.	24	40	38	39	35	43	39	30.05	30.20	
F.	25	40	36	38	34	41	37.5	30.18	30.07	
S.	26	35	39	37	33	40	36.5	29.86	29.55	.09
S.	27	39	31	35	34	45	39.5	29.35	29.25	
M.	28	38	33	35.5	28	44	36	29.21	29.23	.26
		1133	1066	1099.5	935	1247	1091	834.50	832.91	.99
		40.46	38.07	39.27	33.39	44.53	38.96	29.804	29.747	

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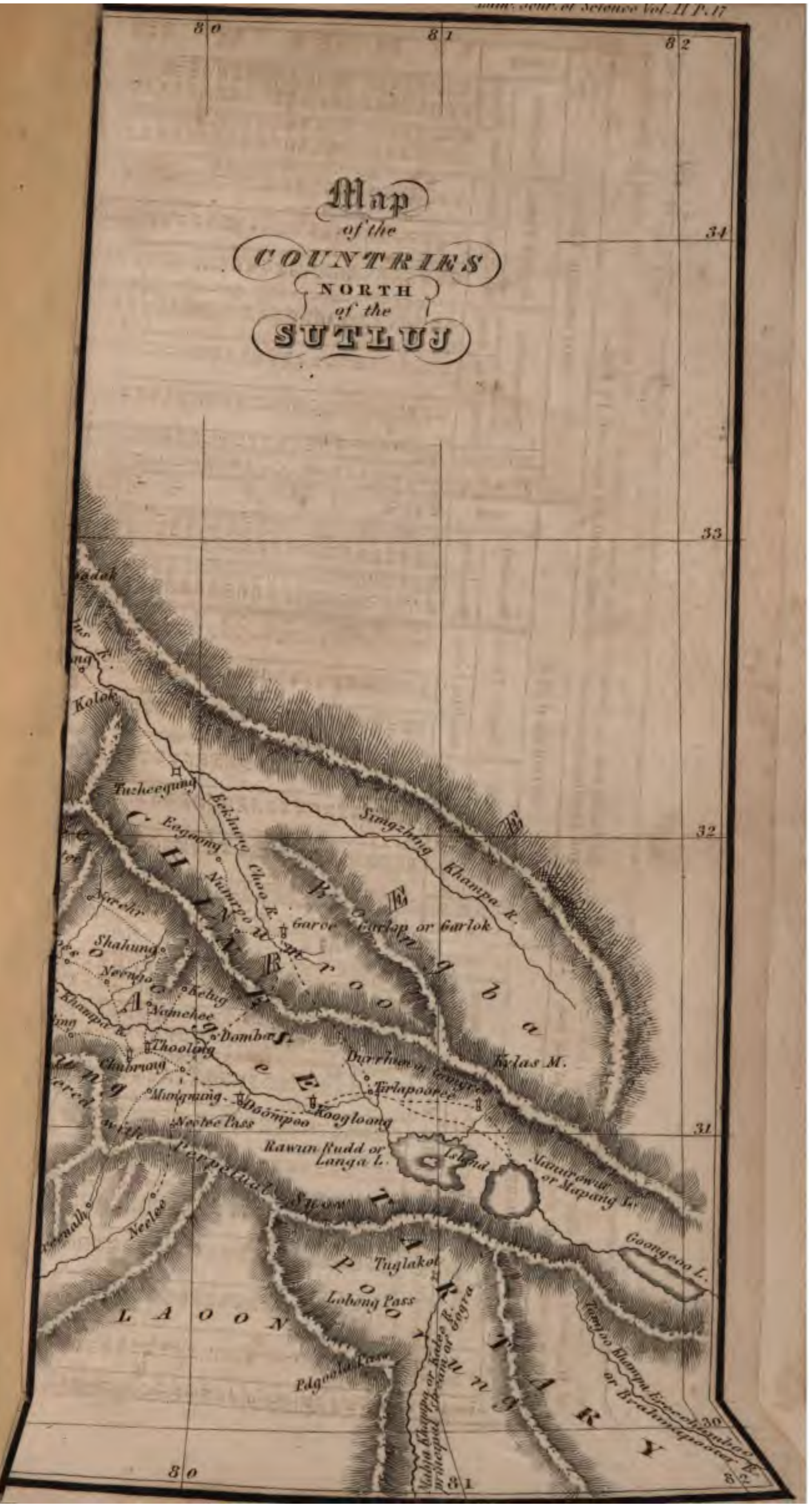
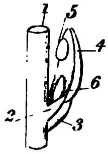


Map of the COUNTRIES NORTH of the SUTLUJ

Fig. 8.



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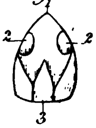

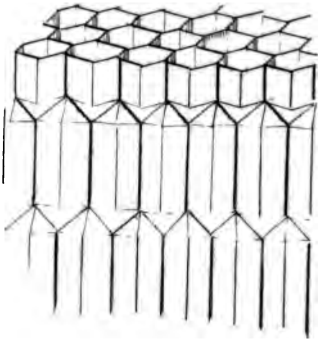

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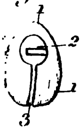

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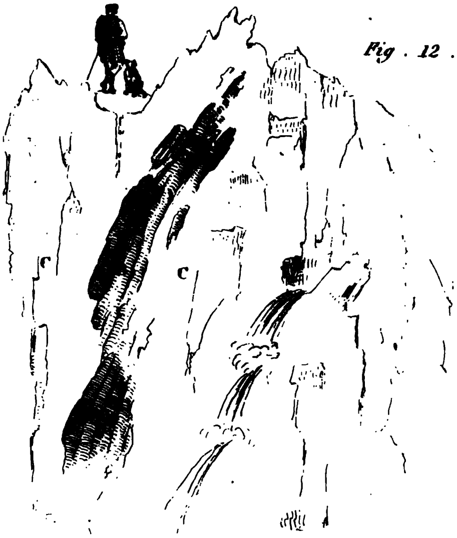

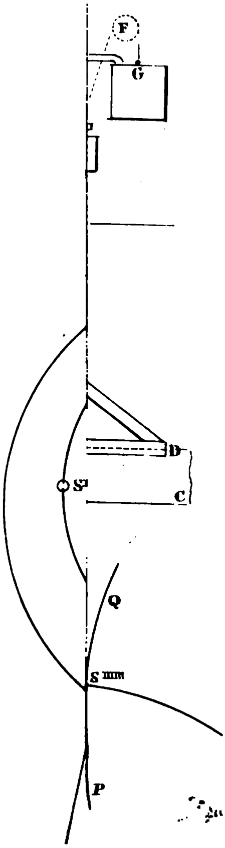

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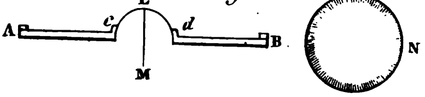

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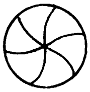

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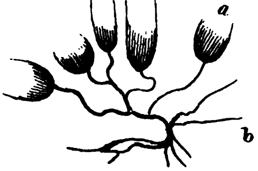

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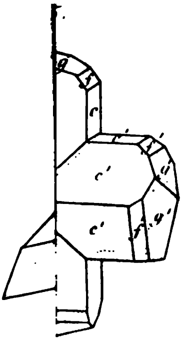

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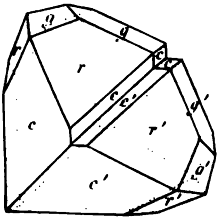

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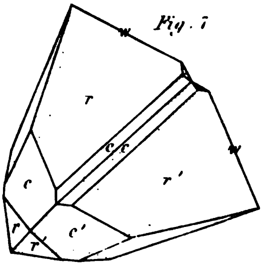

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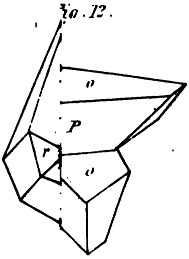

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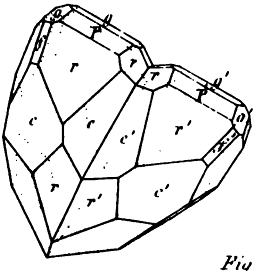

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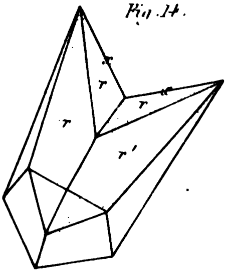
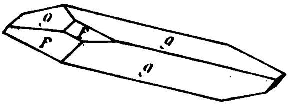


Fig. 20.



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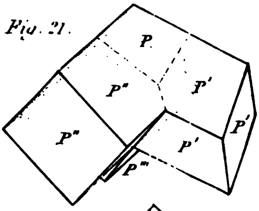

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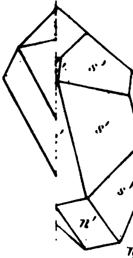

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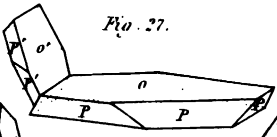

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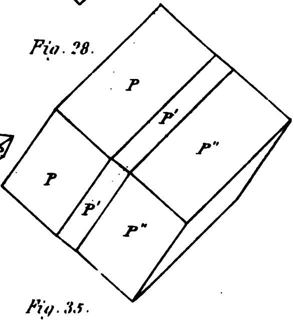
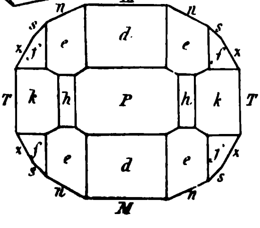


Fig 23

Fig. 31.



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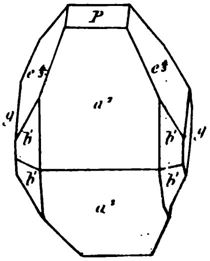

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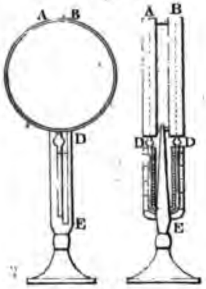
Fig. 10.



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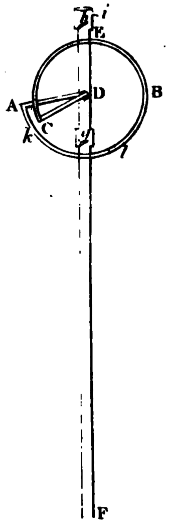

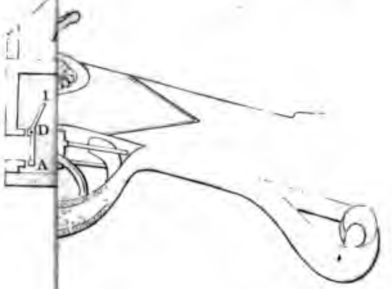

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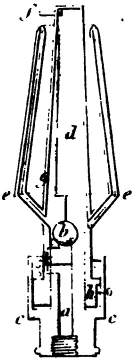
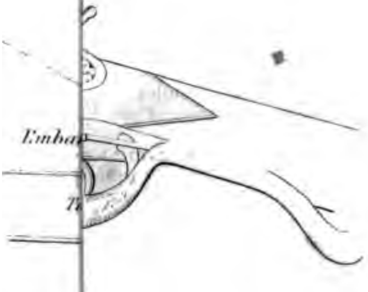
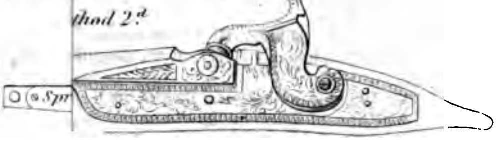
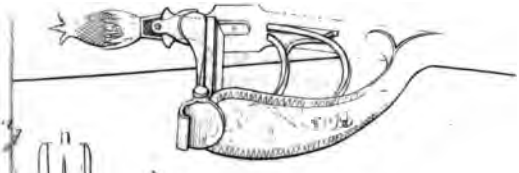


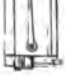


thod 2d





2d Key De



Method 2d

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